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The knowledge which we possess of the pathology and diagnosis of diseases of the respiratory organs, and consequently of a rational method of treating them, is so entirely of modern origin, that it would be useless in a practical work to refer to the writings of past ages for information on these subjects. The essential phenomena and the products of disease were until lately too little understood even to be described accurately; hence the descriptions and names of the older writers, however minutely given and dogmatically applied, are vague and equivocal to the modern reader.

The great improvement that has taken place of late years in our knowledge of diseases of the chest, and consequently in their treatment, has mainly arisen from the careful cultivation of pathological anatomy, and the successful application of physical means of diagnosis in connection with it; in both these departments, especially the latter, we must give the pre-eminence to Laennec, whose *Traité de l'Auscultation Médiate* may be regarded as at once the *novum organum*, and the *principia*, of our knowledge of thoracic diseases. The results and the means of his discoveries have been so far extended and improved by subsequent investigators, as to have changed the subject from being one of the most obscure to be among the most intelligible in practical medicine. It was the defect of Laennec's practice to trust entirely to the physical signs, often to the exclusion of the general symptoms, which are always, especially in regard to the treatment, of the utmost importance. Both sets of signs have their value, and it will be our especial object to point out the modes of appreciating each in the study and treatment of the special diseases; to show, as far as is possible, their relative value, by examining them more fundamentally than has generally been done; and, whilst we pay due respect to authentic records of experience, of whatever kind, to make them still more profitable and instructive by careful analysis and generalisation. It is necessary, however, to study the structure of the pulmonary apparatus; the form, position, and connection of its several parts; their relation to physical laws, and the combinations of these laws in their statical and dynamical forces, that is, at rest and in motion. But in doing this it is soon discovered that the object of our study is more than a mere machine, and that it possesses properties, and is governed by laws which are not met with in inanimate matter. We have the *vital pro-*

perties, sensibility, irritability, contractility, added to the mechanism; we have a *vital chemistry* pervading the materials. Besides the chest, which is mechanically enlarged and diminished, and the lungs and their tubes, which are at the same time expanded and compressed, and the heart and its hydraulic pipes through which liquid is propelled, there are also, in these several parts, the *vital* properties, which not only bind them together in special and complex relations, but connect them also with other organs and members of the body. Here, again, we see the sources of the two classes of signs of health or disease: the *physical*, confined to the organs and their physical or mechanical properties, as exhibited in these organs; and the *vital* or *general* symptoms, the result of vital properties, which are not confined to the part, but may extend their operation and seat over the whole frame. Now, as in the maintenance of health, and in the production or removal of disease, each set of properties is concerned both as causes and as signs, so the necessity of duly appreciating both classes must be apparent.

It being presumed that the reader has studied the anatomy and physiology of the general structure, functions, and relations of the chest and its organs, the next object is to become acquainted with the signs or symptoms, through which, in the living body, we can judge of the condition of the various parts of the structure, and of the performance of their several functions, and thus, through which, we can distinguish health and disease. The condition of the chest and its organs may be examined through two classes of properties, the *physical*, and the *vital*. The physical properties are studied, especially through vision, tact, and hearing. The vital phenomena are studied in the condition of the functions, which are complex properties, or actions dependent on vitality operating in physical structure.

I. Physical Examination of the Chest.

We examine the chest physically through those properties of form, size, proportions, relative position and density of its parts, at rest and in motion, which are appreciable by our external senses. To assist this examination we must previously possess a good general knowledge of the topography of the several organs within the chest; we must know where each severally lies and reaches with regard to the exterior; so that, when we inspect, feel, or listen, at the different regions of the chest, we may define the general outlines of the organs within. This knowledge must be acquired by personal observation, which should be exercised both on the dead and on the living body. In examinations after death, the position of the organs with regard to the exterior should be observed. The moment the sternum is raised, and before the lungs collapse (which may be prevented by closing the nostrils), the extent to which these organs cover the heart and reach downwards, the position of the air and blood-vessels, the height of the diaphragm, and of the abdominal viscera beneath, should be noticed by the student; and he can transfer these various sites to the marks or lines of the exterior. such as the nipples, the edges of the pectoral muscles, the number of the ribs. This habit of comparing the outside with the inside of the chest in the dead body may not, however, furnish a perfect knowledge of what exists in the bodies of the living; for besides that there is much variety in different individuals, there may, on the cessation of the motions and properties of life, be some changes in the size and condition of the organs, and these changes may vary according to the mode of death. Thus it is probable that the diaphragm, relaxed by death, permits the abdominal viscera to encroach on the cavity of the chest further than during life; and the volume and position of the heart and lungs will be affected, not only by this circumstance, but by the condition of the circulation and respiration at the time of death, by the influence of time and temperature on the stiffening of the muscles, and by other changes which immediately succeed death, such as the disengagement or absorption of gases by which the intestines are distended, which vary much in different cases. It is well to be aware of these modifying

circumstances, which can be appreciated only by the habit of personal observation: and it is by such individual experience, rather than from rules and descriptions, that a knowledge of the topography of the organs can be obtained in the study of the dead body.

Examination of the Chest by sight and by touch. The other mode of studying the topography of organs is more exact, but more difficult. It is the personal habit of physically examining the living body. The patient standing, or even sitting, with his arms, trunk, and legs in symmetrical positions, and his chest, if possible, entirely uncovered, and exposed to a good light, we view it in front, behind, and from above, and carefully mark its form and proportions, and the corresponding prominences and depressions of the two sides. A healthy chest is nearly symmetrical, the two sides corresponding in shape and size. The right side is, however, almost always slightly larger than the left, especially at its lower portion, where the difference of measured circumference generally amounts to half an inch. This preponderance in favour of the right side is partly to be ascribed to the contents, the unyielding mass of the liver; but it is probably also connected with a law which pervades the animal creation, giving a superiority of strength and development to the right side. It is supposed by Dr. Stokes and M. Woillez, that the increased development of the right side is rather a consequence than a cause of the greater strength, and consequent use of its muscles; and they say that the proof of this is seen in the exceptional cases of left-handed persons, in which the left side has a superiority in size. We have observed, on the other hand, in most healthy chests, an advantage on the left side in point of height: the apex of the left lung, and corresponding portion of the chest, rise a trifle higher than those of the right. We are not prepared to say whether this be an original conformation, or whether it result from the habitual inflation of the stomach, and the unyielding mass of the heart on the left side giving the chest a greater tendency to upward expansion. When these slight exceptions are known, they will not mislead, and they scarcely detract from the general symmetry of the chest. Whenever there is any considerable departure from this degree of symmetry, or correspondence between the two sides, it becomes pretty certain that there either is, or has been, disease.

It has been stated that the chest should be viewed from *above*, as well as from before and behind. This may be done when the patient is seated on a low seat, with the head a little inclined forward, the observer standing behind or on one side, and looking down on the shoulders. A view is thus obtained of the depth of the chest from front to back, and in this way may often be detected between the two sides a want of correspondence, that is not perceptible by the ordinary modes of inspection. If the patient's strength do not permit him to stand or sit up, the chest may be inspected when he is lying on his back, and this may be done by the observer taking his position, not only at the side, but also at the foot and at the head of the bed, from which the corresponding parts of the two sides can be better seen.

The inspection of the chest is to be applied not only to its statical condition, but also to its motions; and here it is proper to combine manual examination. Whilst, therefore, we are inspecting the chest, we desire the patient to breathe in various degrees; and with the hands and eyes directed to corresponding points of the two sides, we watch and feel the amount and equality of the motions. If the chest is a healthy one, we see the motions as uniform as the chest is symmetrical: the clavicles, scapulæ, and upper ribs rise; the lower ribs rise and spread; and the abdomen swells, as the diaphragm descends at each inspiration. Attentively watching and feeling the chest will often also enable us to trace the limits of some of these movements, so as to indicate the boundaries of the chest. Thus the lower ribs are pressed outwards by the displacement of the abdominal viscera at each descent of the diaphragm, and constitute a fulness below the limits to which the lungs descend, with a slight flatness or hollow above. These appearances have been pointed out by Dr. Edwin Harrison, as

visible indications of the height of the diaphragm and liver. The intercostal spaces and the hollow above the clavicles are also fit marks for this mode of comparison between the two sides. They are strongly marked during full inspiration; and are liable to be more so than usual where the entry of air into the lungs is difficult from obstruction of the tubes, and less so than usual when the obstruction is more in the tissue of the lung from internal effusion or external pressure. There are many other useful details which are soon learned by practice, when the principles of the examination are properly understood. Applying the hand on the region of the heart, we feel the relation of the respiratory motions to that organ. After a full expiration the heart is felt beating about the cartilages of the third and fourth ribs, as well as under the sternum; but as the ribs rise, and the lungs expand by inspiration, we gradually lose the beating; and if it be felt at all, it will now be low as the sixth rib.

There are some general varieties of disordered respiration, which are determined by watching and feeling the motions of the chest. Healthy or perfect respiration is both diaphragmatic and costal; but under the influence of disease the motions may be imperfect, and confined either to the ribs or to the diaphragm. Thus, when the diaphragm is prevented from descending by acute pain in it or below it, or by pressure from below, the respiration is wholly performed by the raising of the ribs; and is called *heaving*, *thoracic*, or *costal* breathing. When, on the other hand, the ribs are immovable in consequence of pain, ossification of the cartilages and ligaments, or paralysis of the intercostal muscles, the breathing is wholly *diaphragmatic* or *abdominal*.

The movements of respiration may be *partial*, while one side of the chest is seen to move much less than the other, or when part of one side moves imperfectly; and this partiality of movement may have its cause in the walls, or, as more usually, it may proceed from impermeability of the corresponding portions of lung, in consequence of various diseases. Thus, when lymph or tuberculous matter in the tissue of the lung, an obstruction of the bronchi, an effusion into or a contracted adhesion of the pleura, prevent the inflation and collapse of a part of the lung, the corresponding walls of the chest will be resisted in their motions, and will be fixed in proportion. Thus in phthisical patients we often see the ribs below the clavicles scarcely moving in respiration, and often sunk on one side: in pneumonia and pleurisy, the lower ribs are more commonly fixed. It is proper to mark further how they are fixed; whether in a state of dilatation, or in one of collapse; whether the affected part remains full after expiration, or is still sunk after inspiration, or whether it is fixed in an intermediate state: we may thus, in certain instances, go some way to distinguish between the different causes of pulmonary obstruction.

Mensuration of the chest is a more exact method of detecting inequalities between the two sides. It is generally practised by fixing with the finger a piece of tape by one end at the mesial line of the sternum, and passing it horizontally around the chest to the same point; then, by taking it off at the point where it crosses the spinous process of the dorsal vertebra, the length of two sides may be at once compared. Great care must be taken to pass the tape horizontally around corresponding parts; and attention should also be paid to the degrees of the respiratory act. The most accurate mode is to compare the measurements of the two sides, on a full inspiration and expiration as well as in the intermediate state. Dr. Stokes recommends the use of graduated callipers to measure the depth and height of the chest, as well as its circumference, which alone is given by the tape. Such an instrument would doubtless afford more exact results; but it is not likely to be introduced into general use. We may mention that we have been in the habit of using the tape for the height also, by measuring from the bottom of the sternum to the hollow under the humeral end of the clavicles, and from the latter spot to the spinous process of one of the lower dorsal vertebræ. The measurement may also be practised from the top of the sternum downwards and outwards, to the margin

of the ribs at either side. These expedients, together with the practice of inspection downwards on the shoulders for the antero-posterior diameter of the two sides, are generally sufficient to furnish the comparative dimensions of the sides of the chest.

Besides external measurement, which is essentially comparative between the two sides, there have been various attempts to measure the internal capacity of the chest by noting the quantity of air that can be exhaled or inhaled. The late Mr. Abernethy proposed to judge of the capacity, and thereby of the soundness of the lungs of a patient, by measuring how much air he could throw at a breath after a full inspiration into a jar inverted over water. Other contrivances have been made to measure how much air can be inspired at a breath from a jar of air inverted over water. The chief objection to these means of measurement is, that their indications are affected not only by the capacity of the lungs, but also by the strength of the respiratory efforts. They are dynamometers for the muscles of respiration as well as pulmometers; and a weak, delicate, or nervous person, with sound lungs tested by them, would be placed below a pleuritic or phthisical patient whose muscular energies are still considerable.

So much for examination of the form, shape, and size of the chest by sight, touch, and measurement. It may often give us important indications; but it will seldom inform us of the nature of the obstructions or changes which it discovers; and it cannot detect many obstructions and changes in their smaller degrees. The chest may be immobile, distended, or contracted in parts, but whether from impervious air-tubes, diseased lung, liquid or air in the pleura, or any other of the various causes, sight and touch will rarely inform us.

Examination of the chest by hearing. We are led, then, to try another sense which may reach beyond the surface, the sense of *hearing*. The acoustic phenomena of the chest should be studied, not only by mere experience, like that by which the infant studies objects by sight and touch, and in time becomes acquainted with them; but also, more rationally, by a generalisation of such experience in the laws according to which the phenomena occur. We must accustom our ears to the sounds in all their varieties, that we may be able by experience to know and distinguish them; but to understand their import, and to read the interpretation which they give to the condition of the parts that produce them, we should study them through the laws under which they occur. We must consider what sound is, how it may be produced, transmitted, and modified; how the contents of the chest may produce it, and, when produced, can change it: and by comparing its general properties with the mechanism of the chest and its organs, we shall be prepared to understand and arrange the phenomena that experience has discovered, or may hereafter reveal to us. By thus learning the acoustic relations of the chest, not merely as isolated facts, but as parts of an applied science, we may be enabled to escape, in great measure, the errors into which unintelligible matters of memory might continually lead us, and we shall be acquiring a rational pathology, instead of resting on an empirical diagnosis.

The character of the present work precluding the introduction of more than a few of the leading principles with regard to sound in general, we must refer for further details to the various treatises on natural philosophy, and to the lectures and treatises of the writer on the physiology and diseases of the chest.

Sound is a certain velocity of motion of a body, or of the particles of a body, resisted with a certain force. The moving and the resisting forces acting alternately in opposite directions, constitute the vibrations of sound, which may be seen in a vibrating cord, and illustrated by the slower motions of a vibrating pendulum. The transmission or conduction of sound is the communication of the sonorous motion from one body to another, as one ball striking another ball moves it. The reflection of sound is the refusal or

rejection backwards of this motion by bodies which cannot receive it, as a wall throws back the motion of a ball. Sound is most readily produced and sustained in bodies of uniform density and elasticity, the particles of which transmit and continue, and do not reject or choke each other's motions. Hence tense and rigid bodies produce and conduct sound better than those which are flaccid and soft. Bodies of very different density and elasticity do not readily receive sound from each other; because their powers of motion differ in force and extent, and must cause them to reflect or choke the motions which they receive from each other. Thus a sound produced by air is intercepted by a solid; and that produced by a solid is far better transmitted by a solid of the same density and elasticity, than by air. The sound of a body much more dense than air, such as metal, may be communicated with greater freedom to air by the medium of a third body of intermediate density, such as wood, and this effect may be increased by extending the surface, and lightening the mass of the third body, as it is done in the sounding boards of musical instruments. The note or pitch of a sound depends on the frequency of the vibrations, those of the highest or shrillest notes being the quickest. The duration of a sound depends on the continuance of the vibrations. The sources of sound are such impulses as those which affect bodies suddenly, or with some force. Thus the percussion, collision, friction, tightening and breaking of solids cause sound. Sounds are not often produced in air or in liquids but by the aid of solids, which either communicate the motion or offer the resistance: thus we hear the wind only when it whistles in a key-hole, in the rigging of a ship, the leaves of a tree, or the like; and the sound of wind instruments depends on the motion or on the resistance of a solid. But liquids and air together readily generate sound without the aid of solids, by their impulses on each other; and thus are caused all the bubbling and rushing noises of liquids, from the frothing of beer to the roar of a cataract.

Examination of the chest by percussion. As the nature of metal, wood, and other bodies is tested by the sound which they yield on being struck, so we strike or percuss the chest to judge of the nature and condition of its materials. The practice of percussion as a mode of diagnosis, we owe to Avenbrugger; it has been applied and improved by Corvisart, Laennec, Piorry, and others, and now constitutes an important mean of diagnosis in diseases of the chest and abdomen. When the principles on which its indications depend, are well understood, the practice becomes easier as well as more instructive; and as we believe that no preceding writers have exposed these principles correctly, it will be well, after stating the general phenomena of percussion, to explain them by a few familiar illustrations.

The chest when struck abruptly with the ends of the fingers, yields a rather deep and not very short sound; which implies that the vibrations are not quick, and that they do not instantly cease. If we strike in the same manner on the thigh, a very different sound results, a short dull tap, implying that the vibrations have no continuance. The same dead tap is obtained on striking the lower part of the chest on the right side, where the liver lies; but all those parts under which the lungs are, yield more or less of the deep hollow sound. Is the seat of this sound in the air, or in the solids of the chest? If it be in the air, like that of hollow bodies, it ought to be changed by the same circumstances which modify the sounds in them. Thus, if we take an India-rubber bottle, and strike it, we find that its note is quite different when its mouth is open, from that which it yields when it is closed. But closing the glottis, or aperture into the chest, does not materially change the sound of pectoral percussion. Again, the sound of hollow bodies is deep in proportion to their size. Thus a large India-rubber bottle gives a much deeper tone than a small one; and its note is raised on diminishing its cavity by compression. It is not so with the chest; for enlarging or diminishing its hollow does not in this way change its sound on percussion: the extremes of inspiration and expiration only slightly raise it.

As the sound of percussion of the chest does not follow the law which regulates sounds produced in the air of hollow bodies, we must conclude that it is seated in the solid; and if we study the construction of the chest, we shall see how well-adapted its solids are to vibrate. Composed of layers of membrane, thin muscles, and integument stretched on an elastic frame of bone and cartilage, the walls of the chest are free to vibrate so long as the organs within do not check their motions: were there nothing but air within, these motions would be perfectly unembarrassed, and the sound would be more prolonged and hollow in consequence, deriving also an additional tone from the note of the cavity within, as in pneumothorax, or over an inflated stomach. The light, soft, spongy tissue of the lung scarcely interferes with the free vibrations of the walls, whilst the slight sound of its own which it yields, is equally deep with that of the walls with which it becomes combined. Hence, where healthy lungs lie in contact with them, the walls of the chest give a deep clear sound. But below the sixth or seventh rib on the right side, which is over the liver, and to the left of the lower part of the sternum, which is over the heart, the sound is dull and short, the vibrations being checked by these solid organs beneath; so it is obvious that morbid changes of the organs, such as a condensation of the lung, or the pouring out of serum into the pleural sac, would in a similar way arrest the vibrations, and render the sound of the chest dull in those parts where these changes occur. On the other hand, changes of an opposite kind, such as dilatation of the air-cells of the lungs, or an effusion of air into the pleural sac, may make the vibration of the walls more free than usual, and thus increase the sound obtained on percussion.

These illustrations are enough to show the general principles of the acoustic examination of the chest by percussion. It is a test of the density and elasticity of the materials within the chest: as diseases alter these qualities, so will they alter the sound on percussion which may thus announce their presence. A few more considerations will suggest some practical application of these principles. As we have seen that the walls of the chest give the sound which we hear on striking the chest, so it is plain that they must be sufficiently tense and elastic to vibrate on being struck. The chests of some persons are so loosely put together, and so flaccid, that they give but little sound, although the organs within are quite healthy. In others, again, there is such a mass of fat and loose integument on the chest, that the walls are completely muffled by it, and they sound but little on percussion. The same difficulty occurs, in other cases, in certain regions where muscles of considerable thickness, or the mammæ in females, lie on the walls. In other instances again, the walls of the chest are so drawn in by contracted adhesions of the pleura, that they are too tight to vibrate, and give a hard or dull sound, although the lungs within them may be comparatively healthy. In all these cases we must give to the part struck the equal tension which is wanting, by pressing on it a small piece of some firmly elastic body, such as wood, ivory, stiff India-rubber, or some such substance. This, when struck, gives sound enough; and if it be firmly applied to the chest, the density of the contents within will modify this sound, just as it modifies that of percussion on the naked walls of the chest. The sound obtained by striking a little plate of ivory or wood thus pressed on the chest, is the same in character as that of striking the chest itself; but it is louder, and as percussion on it gives no pain, the stroke can be applied with such force as to make the vibrations reach the interior through any thickness of fat or muscle. By these means we can test the sonorous qualities of the thoracic viscera through the scapulæ and muscles of the back, and through fat or œdematous integuments of any thickness. In this way, too, we can try the resonance or sonorous quality of any part of the abdomen.

We owe this method of *mediate* percussion to M. Piorry, who calls this percussion-plate a *pleximeter*. Mediate percussion is so much better than the immediate kind, that it is now generally preferred. There is, however, an

improvement on it which was, we believe, first proposed by Dr. Skerrett; it is to substitute for a pleximeter the fingers of the left hand. This mode of percussion has the advantage of convenience as well as of yielding distinct results. Its adaptations are soon found out by a little experience — in fitting the fingers to the inequalities of the chest, sometimes singly, sometimes together, sometimes with their palmar surface outwards, but generally with this applied to the chest and the back to strike on, with other varieties of manipulation to be hereafter noticed.

To understand the varieties of sound of percussion, and their situations in the chest, it is necessary to bear in mind how the contents of the chest lie in relation to the surface. This varies considerably in different healthy individuals, but the following may be given as an average statement of the position of the thoracic organs after an ordinary expiration. The lungs are in contact with all the upper and middle portions of the walls of the chest. On the right side they reach down to about the sixth rib in front, and the eighth rib at the side, below which the liver comes in contact with the walls, and still lower in the back. On the left side they reach to about the seventh rib in front, except within two or three inches of the sternum, where they seldom reach lower than the fifth rib, there being a space of from one to two superficial inches under and to the left of the sternum, where the heart lies in contact with the walls; at the side they reach to the eighth rib, whereabout they are bounded by the stomach and spleen, which, with the colon, also bounds them behind, where they reach a little lower. Inspiration greatly alters these limits, both by raising the ribs and expanding downwards the lungs, which then reach a rib lower, and a full inspiration may bring them in contact with nearly the whole of the thoracic walls, while expiration has the converse effect.

The sound on percussion corresponds with this description, and by it we may therefore know the position of the organs in a living subject. Thus in all the upper parts of the chest, before, behind, and at the sides, the sound is clear, and equal on both sides. There is also some clear pulmonary sound in the inferior parts of the chest down to the limits to which the lungs reach. But below the fourth rib in front on either side, although the lungs are in contact with the walls of the chest, their lobes are not thick, and beneath them lie the liver on the right side and in front, and the heart and stomach in front and to the left. The vicinity of these organs modifies the sound on percussion, and the more so, the nearer they approach to the surface, where the lungs become thin towards their margins, until they quite give place to the peculiar sounds of these respective viscera about the limits before named. There is, therefore, a very slight deadening of the pulmonary sound below the fourth rib on the right side, below the middle of the sternum, and below the third rib near the sternum on the left; and this deadening increases down to the margin of the lungs, where the sound has the perfect dulness of the solids of the liver and heart. Further to the left the sound takes more or less of the hollow tympanitic character of the air-filled stomach. It appears, then, that the stroke of percussion reaches to a considerable depth, to organs an inch or more from the walls; and whatever it reaches, may modify the sound. This suggests to us, that, by varying the force of the stroke, we may make the impulse of percussion reach to different depths, and derive the character of its sound from the superficial, or from the deep-seated organs, as we will. Thus, where the lung overlaps the liver, *strong* percussion will give a shorter deader sound than gentle percussion. Strong percussion receives the character of its stroke from the liver, as well as from the lung; whilst gentle percussion, such as by filliping with the finger and thumb, does not pass through the thin layer of lung, and gives still the pulmonary sound. The same mode of percussion may distinguish the utmost limits of the lungs over the heart. It is more difficult to determine by percussion the precise limits of the lung on the left side; for, in consequence of the loudness of the hollow stomach sound, and the facility with which it may be elicited, it is apt to disguise the pulmonary sound, even with the most gentle

percussion. In this case more may be done by observing the amount of expansion of these parts by a full inspiration. The extent of this stomach sound varies according to the state of gaseous distension of the stomach; it not unfrequently reaches, in a slight degree, above the mammilla. There is sometimes a slight dulness on the left side behind, corresponding with the position of the spleen; and in case of enlargement of this organ, the dulness may become extensive.

It must not be forgotten, that the motions of respiration may produce changes in the character and position of some of these sounds. Inspiration, as it enlarges the lung, renders the pulmonary sound clearer, and extends it over every part of the heart, and over a considerable portion of the liver. As the complete and equal enlargement and contraction of the chest, as seen and felt, are signs of the free conditions of the respiratory organs, so the sound on percussion becomes an additional sign of the healthy action, in proportion as the clear pulmonary sound is extended at each expansion of the chest. Percussion is a test, therefore, not only of the statical condition of the lungs, but of their dynamical state also. This point is not enough attended to by auscultators; yet the neglect of it not only would deprive us of additional signs, but would tend to render deceptive the results of statical percussion. For example, in judging of the goodness of sound on percussion, we generally compare the sounds on the two sides of the chest, where in health the structures and sounds are the same; but if we do not attend to the movements of respiration, we may strike one part when the chest is contracted, and the other when it is full, and obtain results which differ from this cause only, and not from any internal change. In practising comparative percussion, therefore, in cases requiring delicacy, it is proper to desire the patient to hold his breath for an instant while the comparison is made; and it is often useful to try the sound when the chest is expanded to the utmost, when it is contracted, and in the intermediate states.

The varieties in the sound of percussion from special diseases will be considered when those diseases are described, but a few examples will be useful here to illustrate the subject. The indurations of the upper lobes of the lung are often small, and so scattered through its substance, that they scarcely affec the sound on percussion; but by a full expiration, they are brought closer together, and if more on one side than on the other, they may then sensibly deaden the sound on that side, especially if gentle percussion be used below the clavicles, and not on a very small surface. Again, the indurations, especially if of some standing, tend to restrain the lung from its full expansion; and if there be a difference on the two sides, it thus may be detected only on a full inspiration. In the disease called emphysema of the lungs, the air-cells are permanently dilated: they contain an unusual quantity of air, which expiration cannot expel: this may be detected by percussion used as a dynamical test; the regions of the heart and middle part of the liver being covered by the permanently distended lung, give, even after expiration, a clear sound. There is one more point to be noticed respecting percussion at the extremes of the respiratory act. Full inspiration makes the sound clearer: full expiration has the contrary effect; but they both raise the note a little; they make its pitch higher. This is in consequence of forcible inspiration or expiration, which are muscular actions, straining the walls of the chest, and thus rendering their vibrations quicker, and therefore the sound higher, as in tightening a drum.

It is unnecessary to add more on the principles of percussion; but it will be useful to give some directions with regard to the practice. In this as in every other art requiring some manual dexterity and the exercise of the senses, practice is necessary to familiarise the beginner with the phenomena and the mode of obtaining them.

In obtaining the sounds of percussion, he soon finds that some dexterity is necessary even in mediate percussion, which is the easiest mode. The fingers or pleximeter should be closely pressed on the walls of the chest; and if the

object be comparison between the two sides, they should be placed on corresponding parts, whether between the ribs, along them, or across them. Care should also be taken that the mode of striking be the same, whether it be with one or several fingers, with their tops (in which case the nails should be kept short) or the flat of the last phalanx, or with the knuckles, each of which modes is sometimes preferable. Filliping with the middle finger and thumb often gives more uniform and delicate results, especially when the patient is in an inconvenient position, or suffers from tenderness of the walls of the chest. This is also the best mode for abdominal percussion. When striking the clavicle, attention should be paid to what part is struck; for the sternal portion of this bone always sounds much clearer than the humeral end: so also in percussing this or any other part, the direction of the stroke should be perpendicular towards the lungs, and not sideways, or the sound will be modified, not by the lungs, but by the adjacent muscles or other parts towards which the impulse is directed. It is from neglecting this precaution, that beginners sometimes get nothing but dull sounds all over the chest. It is not generally necessary to use much force in percussion: in fact, many of the most valuable results are obtained by gentle mediate percussion; but the mode must be varied in different cases. When it is desired to test the density of a small spot, percussion with a single finger is best; whilst for trying a surface of greater extent, flat percussion with several fingers answers better. In doubtful cases it is proper to try both. In percussing the regions of the back and shoulders, the bony prominences of the scapulæ and ribs should be sought, for these transmit the impulse to the interior far better than the thick layers of muscle. But as the scapulæ are movable bones, it is necessary to see that they are in corresponding places on both sides; and to insure this, and to increase the tension of the muscles, it is well in examining these regions to desire the patient to cross his arms in front, and to bend his head forwards. At that part of the chest near the humeral end of the clavicle, a most important region for examination, there is often a falling away of the chest; and the more tense the pectoral muscles are made, the further they are removed from the walls: here then, instead of making the muscles tense, they must be relaxed, by letting the elbow hang close to the side, whilst mediate percussion is practised in this region.

The best posture of the patient for percussion is erect or sitting; and in comparing the two sides, both before and behind, the observer should be directly opposite the front or the back. When the patient is lying down, the sound is modified by the matter on which he is lying: if it be a soft featherbed, the sound is more dull; if a mattress, or any thing hard, the sound will often be increased, because the elasticity of the contents of the chest is increased by the unyielding matter behind it. So also the vicinity of a wall or other hard surface causes a reverberation which gives to the side nearest to it too loud a sound. On the other hand, the vicinity of curtains or other drapery deadens the sound. As most of the effects of percussion are judged by comparison, the chief object of the cautions given is to take care any of the external causes of modification may not act unequally on the different parts of the chest. The patient may sometimes be removed from the influence of these to the middle of the room; and when this cannot be done, these modifying causes must be equalised as much as possible.

Little needs to be said about pleximeters, for they are not generally necessary: M. Piorry much exaggerates the advantages derived from them. A thin circular plate of wood or ivory, with two projections or a raised rim by which it may be held firmly to the chest, is one of the best forms: the surface to be struck should be covered with soft leather, to prevent the clack of the fingers on it. We give the preference to a little oval piece of boxwood, about an inch long, three quarters of an inch wide, and one eighth of an inch thick, with a strong handle two inches long rising from its outer margin, at an angle of about forty-five degrees. The handle is convenient for holding it firm to the

chest without interfering with the percussing fingers.* The chief precaution necessary in using it, is to take care that it be applied flat and not tilted.

Auscultation of the respiration. Let us now inquire into other modes of producing sounds in the chest, which may prove signs of the condition of the organs within. The contractions and relaxations of the muscles of respiration are in general too gentle to cause sound; but when forcible or sudden, they sometimes produce a sound of tightening, a kind of muscular sound. This is often evident when there is an abrupt catch in the breathing, and during the act of coughing, though it does not furnish any sign of importance. But the internal motions and passage of air to and from the lungs produce sounds; and inasmuch as this passage of air is the great object of respiration, we may expect to find in these sounds signs of the manner in which this object is accomplished. These and most of the other acoustic motions of the chest were first discovered and described by Laennec, who may well be regarded as the father of the art of auscultation. We shall endeavour so to illustrate and extend this art by the aid of physical and physiological science, that we may be enabled to deduce respectively from the phenomena the condition of the organs, and from any known condition of the organs the phenomena which it would produce.

The air enters the lungs by atmospheric pressure, to fill the increased space made in the chest by the action of the muscles of inspiration. On its way to the most expansible parts of the lungs, the fine tubes and cells, it strikes against the sides and angles of the larynx, trachea, and its ramifications, with force sufficient to produce a particular hollow blowing sound. We may hear this on applying the ear to the fore part of the neck, or at the top of the sternum. As the current of air becomes subdivided and spread in the small bronchi, it loses a part of its velocity, and the sound becomes of a more diffused and less hollow character: it is more like the sighing of a gentle breeze among the leaves of trees; and in passing into the cellular terminations, all of the hollow tubular sound is lost, as may be perceived on applying the ear to most parts of the chest where the lungs lie. This sound seems to depend here chiefly on the impulse of the air against the angles and sides of the minute tubes and cells, but partly also on the opening and stretching of these cells, and perhaps partly on a propagation of the louder sound of the passage of air in the larger tubes. Where inspiration ceases, expiration begins; and a portion of air is pressed out of the cells and small tubes by the collapse of the walls of the chest, and by the contracting properties of the pulmonary tissues. There is a remarkable difference between inspiration and expiration; in inspiration air is the moving body, and rushing through the tubes distends the passive lung: in expiration the lung is the moving body, and by its contraction (backed by external pressure) drives before it the passive air. In either case there is a pressure exerted between the air and the interior of the cells, and doubtless this proves the means of assisting the chemical changes that take place. But it is plain that there must be a difference between the sounds of inspiration and expiration. In inspiration air moving with some velocity meets with the resistance of the angles and sides of the tubes and cells which it has to dilate. Here must be sound in the whole passage of the air, from the nostrils down to the pulmonary cells. In expiration the motion begins with the lungs; and the air passively yielding to it, there is not motion or resistance enough to produce sound, until by the converging together of the small tubes the impelled air is gathered into a current in the larger tubes, where, impinging against their sides with its now acquired velocity, it at length produces sound. These remarks explain why in natural inspiration there are three kinds of sound produced by the motion of the air through different parts, and hence called *tracheal*, *bronchial*, and *vesicular*. In expiration there are at most only two, bronchial and tracheal. These differences, which were overlooked by Laennec, have been

* A sketch of this form of plexiмeter is given in the writer's lectures, published in the *Medical Gazette*.

noticed by Andral, Louis, and Dr. Cowan, who ascribe their discovery to the late Dr. Jackson, a young American who studied at Paris. They deserve attention, and are obviously dependent on the causes which have been mentioned. It is needless, however, to distinguish them in general descriptions, and we shall class them together as the sounds of respiration.

The sounds of respiration can be heard on applying the ear to different parts of the chest, being transmitted through the parietes to the parts beneath with sufficient distinctness; and as the healthy sounds vary in these different parts, we may judge of the natural distribution of the tubes, by listening to these sounds. Thus we find in any part of the neck, and at the upper part of the sternum, there is the hollow blowing sound which results from the passage of air to and fro in the trachea, which is therefore called *tracheal* respiration. A little lower down than this, over the space of two or three inches on each side of the top of the sternum, between the scapulæ, and sometimes in the axillæ, there is the sound called *bronchial* respiration, its whiffing or tubular character denoting that it is produced by the passage of air in the bronchial tubes. In most other parts of the chest is heard the *vesicular* respiration, which is a diffused murmur caused by the air penetrating through the minutest tubes, and into their numerous vesicles or cells.

The question naturally occurs, why is the bronchial respiration heard in comparatively few parts of the chest, when bronchial tubes of considerable size are distributed in so many parts of the lungs, within an inch or less of the surface? Why is not the sound a mixture of the tubular and vesicular sounds? The answer and explanation is, that in consequence of its softness and inequality of density, the healthy tissue of the lung is a bad conductor of sound, and does not transmit the sound of bronchial respiration to the surface, except in points where the tubes are large, and approach quite close to the walls of the chest. The flaccid tissue, composed of the different materials, membrane and air, effectually arrests all the slighter sounds produced in the tubes within it. An important corollary from this is, that, as this arrest of the sounds of the interior depends on the light spongy structure of the lung, so any disease, increasing the density of that structure, augments its conducting power, and enables it to transmit the sounds. Hence we find that a great increment of solid or liquid in the lung, as in pneumonia or tuberculous disease, or the compression of its superficial parts by a moderate quantity of liquid in the pleura, as in a recent pleurisy, often not only diminishes the vesicular murmur in consequence of the obstructed state of the cells, but also adds a bronchial or tubular sound of breathing in those parts where naturally the respiration is purely vesicular.

As the several sounds of respiration depend on the resisted motion of the air, so they vary according to the velocity of that motion, and the degree and nature of the resistance to it; they are loud when the air passes in and out forcibly and quickly, and low when it passes gently and slowly. So, on listening to a person's breathing, it may be scarcely audible at its ordinary rate; but if he breathe quick and short, it will be distinct enough. Taking a long breath may not answer the same purpose; for although much air is thus taken in, it may not enter with sufficient rapidity to cause the increased sound. Coughing answers better, for the full inspiration which succeeds coughing is generally quick also; and it is often useful, where the sounds are obscure, to magnify them by this more forcible act. But there is a limit to this power of increasing the sound of respiration by increased effort. If an individual tries to breathe very hard and quick, as after violent exertion, the movements of the lungs cannot keep pace with those of the external muscles of respiration, and the air does not freely enter, the sound will be diminished or altered rather than increased.

As we can vary the sound of respiration by varying the act in the same individual, so we find that a difference exists naturally in different individuals; in some, as in many robust adults, the ordinary respiratory sound is very low

and faint; in others, as in children, in nervous females, and in slight irritable persons, it is loud and distinct. In the last-mentioned cases, the respiratory movements are more brisk; and although air may not be taken in more frequently or in such great quantity as in other cases, yet it enters more suddenly, and meets with greater resistance in its passage, so that it must cause more sound. As this loud respiration is commonly met with in children, Laennec called it *puerile* respiration. So, also, by rendering the respiration quicker and more energetic, it may be made to sound loud in those cases in which it is naturally faint, as by the quick short breathing just mentioned, or, better still, by desiring the person to hold his breath for a while; the quick strong inspiration which follows, is noisy enough. Disease sometimes brings about this same change; thus, if a considerable portion of the lungs be obstructed, the force of the act of breathing will be concentrated on the remaining portions, and the air will be carried in and out of them with unusual energy and noise. Hence Andral terms this partially increased respiration *supplementary*. So also, under some circumstances, without any obstruction, the want of breath may be increased, as it happens during moderate exercise, in some degree during digestion, and on exposure to cold; here the whole respiration is more energetic and its sound louder. Further, as the act of breathing depends on a particular impression of the nervous system, so it may be supposed, when this system is preternaturally sensitive, the ordinary impression produces an increased effect; here, again, the respiration becomes more energetic and noisy. This appears to be the chief cause of the increased sound of respiration in fevers and other diseases where the nervous sensibility is exalted. Lastly it is possible, by an external restraint of some parts of the chest, to render the sound of respiration louder in other parts. Thus, by inclosing the abdomen and lower part of the chest in a tight belt (and the experiment is already prepared in the persons of tight-laced females), the sound of respiration is made unusually loud in the upper parts; and it may be seen by the heaving of these parts how their motions are augmented. Acute pain or tenderness of some of the parts moved in respiration would have somewhat of the same effect as a ligature, for it would cause an instinctive restraint of these parts, which would throw on others supplementary labour.

It appears, then, that there may be much variety in the sound of respiration without disease of the lungs; and except in the case last mentioned, it is where there is a comparative discrepancy in the several parts of the lungs rather than any absolute difference, that disease of these organs is indicated. Thus, if we find the respiration loud on one side and obscure on the other, or clear in the lower part of the chest, indistinct in the upper, we may well suspect some obstruction to exist in those parts where the sound is obscure; and the nature of that obstruction is then to be tested by percussion and other means.

There is another kind of variation in the respiratory sound that has not been attended to — that which affects its duration. In this, as in other varieties, there are absolute differences in different individuals, and in the same individual under different circumstances; but we shall only notice the comparative discrepancies in the same subject and at the same time, which alone constitute signs of disease. We may hear the sound of inspiration on one side distinct and prolonged during the whole inspiratory act, whilst on the other side it is loud enough at first, but is abruptly arrested before the act is complete, and it is stopped with a sort of hitch. Hepatisation or compression of the lower portions of the lungs will do this; so will a movable plug of tough mucus in the bronchial tubes. In other cases, again, we find the circumstances reversed: there is in a part of the lung no sound during the first part of inspiration; but towards its end, when the chest is most expanded, there is a short wheeze. This happens where the bronchial tubes are so far obstructed that air will not pass through them, until they are distended by a full inspiration, as in bronchitis. It appears also in extensive pleuritic effusions which distend the parietes of the chest beyond the medium state of respiration; it is

only the acmé of inspiration that can then introduce air into the compressed lung, and it is at this period alone that the respiratory sound is heard.

There are other morbid varieties of respiration, such as *cavernous* respiration, caused by the passage of air in and out of an unnatural hollow or cavity in the lung; and where this cavity is very large, the sound becomes *amphoric*, like that of blowing into a phial. These and other varieties will be noticed when we treat of the diseases which produce them; and are included in the tabular view of the sounds given further on.

Rhonchi. We have hitherto considered the sounds produced by the passage of the air to and fro in the lungs, and we found that the varieties of these sounds depend on the size of the tubes, and on the force with which the air strikes against their sides and angles, and that they may be shortened or stopped by various kinds of obstruction. We have now to describe a class of novel sounds which arise from partial obstructions to the passage of the air; obstructions which permit the air to pass, but not without such a resistance as causes an increased and modified sound. Thus, if a bronchial tube be narrowed by the swelling of its membrane, or by mucus secreted by it, the air will pass through the narrowed portion with increased velocity and increased resistance; and hence the sound is changed from a simple breathing or blowing to a louder wheezing, bubbling, whistling or snoring, according to the nature of the obstruction. These new sounds Laennec called *rales* or *rattles*. We prefer the Latin term *rhonchus* (which is from the Greek ῥόγχος), as more expressive; and it has been adopted by most English writers. If there were one, it would be desirable to use an English word, for nothing injures the purity of a language more than the introduction of foreign words.

The rhonchi may be divided into the *dry* and the *humid*, according as the impediments that produce them are solid or liquid.

Of the *dry* rhonchi there is the sibilant or whistling rhonchus, which is sufficiently described by its name, and may generally be imitated by whistling between the teeth. It is produced by the passage of air through a small and somewhat circular aperture; and this aperture may be formed by a slight obstruction of a small tube, or by a greater obstruction in tubes of larger size. It generally occurs in tubes narrowed by swelling of their mucous and submucous coats, such as occurs in the early stage of acute bronchitis; but it is heard also in asthma, where the tubes are congested and constricted by the spasmodic contraction of their circular fibres; and it may happen, also, when viscid mucus clings to and diminishes the caliber of the tubes.

The sonorous rhonchus is a snoring, humming or droning sound, and may vary in loudness or key, from an acute note, like that of a gnat, down to the grave tone of a violoncello or bassoon. It must be produced by an obstruction leaving a flattened aperture, the lips of which, or the moisture on them, yield to the passing air with a vibrating resistance. Partial swelling of the sides of a tube, particularly at its bifurcation, a pellet of tough mucus in it, or external pressure on it, may cause such a flattened opening within the tube; and the sound in question, therefore, occurs in various forms of bronchitis, and often accompanies tumours which press on the bronchial tubes. When caused by tough phlegm, coughing generally changes or removes it; when from the other causes, it is generally more permanent. When quite permanent, it usually depends on the pressure of a tumour, or some deposit outside the tube. The key or note depends chiefly on the size of the aperture left: when this is small, the note is high; when large, it is more of a bass: from this may be inferred, that the latter can have its seat only in the large tubes; but as a more considerable obstruction may flatten their caliber to the smallest size, these may also be the seat of the acute notes. Almost every variety of this rhonchus may be imitated by blowing between the lips moistened with saliva, and almost closed.

There is another rhonchus, which may be called the dry mucous, because it is produced by a pellet of tough mucus obstructing a tube, and yielding to the

air only in successive jerks, which cause a ticking sound like that of a click-wheel. When the air is driven very fast, these click-sounds pass into a continuous note, and constitute the sonorous rhonchus. Sometimes, again, particularly in inspiration, the click-sound suddenly stops, the tough mucus being forced into a smaller tube, which it completely closes, and may not be dislodged again, but by dint of forcible coughing.

Now, as any of these rhonchi may be produced in only one tube and yet be very loud, it is not to be supposed that they are important in proportion to the noise they make. It is rather when they are permanent, or when several of them are heard at once in different parts of the lungs, that they bespeak disorder that may be serious, either from its continuance or from its extent.

The *humid rhonchi* depend on the passage of air in bubbles through a liquid in the lungs, and their varieties are produced by differences in the size of the tubes, and in the nature and quantity of the liquid, which cause varieties in the bubbling sound. A bubble is a portion of air contained, and slightly compressed, by a thin film of liquid, which preserves its integrity by its molecular or aggregative attraction ; when this attraction is overcome by the gravitation of the liquid, the motion of the air, or any other disturbing cause, the bubble bursts; as it bursts, the air from it, slightly expanding, gives to the adjacent air an impulse which, if forcible enough, produces sound. In the bubbling passage of air through a liquid, the air is the moving body, the liquid gives the resistance; and in proportion as these are strongly and suddenly opposed to each other, the louder will be the sound produced. If the air pass with force, it makes most noise in a liquid of some tenacity, which offers it most resistance ; but if it move slowly, such tenacity may retard the breaking of the bubbles, and therefore diminishes the sound. Again, air passing through a liquid in large tubes, gives most sound when the liquid is thin, because the bubbles form and burst quickly ; but in passing through very small tubes, air causes more sound with a rather viscid liquid, which, adhering to the tubes, is not carried before the air so readily as one of a thinner nature. This rule is applicable to bubbling sounds or rhonchi heard in the chest.

The *mucous* rhonchus may be heard in large and smaller bronchi down to the size of a crow's quill ; and in these tubes its gurgling or crackling presents different degrees of coarseness. It is an irregular and varying sound, composed of unequal bubbles, and often interspersed with some whistling, chirping, or hissing notes. Its most common cause is acute bronchitis, which, after its onset, is attended with a secretion of liquid mucus into the bronchial tubes; and the passing of the sibilant and sonorous rhonchi of the first or dry stage into the bubbling of the second or secreting stage, is often marked by a curious combination of chirping and cooing notes, like those of birds in a bush. When the bronchial tubes become enlarged by disease, or when morbid cavities are formed by the destructions of portions of the lung, the bubbling of air through liquid in these is of the coarsest kind ; it is quite gurgling, and, if the liquid be scanty, has a hollow character, and is called cavernous rhonchus.

When there is a little liquid in the smaller bronchi, the bubbling or crackling is more regular, although the sound is weak, and is sometimes only a roughness added to the ordinary respiratory murmur. This is the *submucous* rhonchus. It may result from slight degrees of bronchitis, and owes its importance only to its being permanently present when such slight inflammation is constantly kept up by the irritation of adjacent tubercles in an incipient state.

When there is more liquid, not viscid, in the smallest tubes and terminal cells, the rhonchus has a still more crepitating character, and resembles that heard on applying the ear near the surface of a liquid slightly effervescing, such as champagne or bottled cider. This is the *subcrepitant* rhonchus, which is heard in œdema of the lungs, humid bronchitis, and other affections in which liquid and air occupy the extreme tubes, and are forced through each other in the motions of breathing.

But the most perfect and equal crackling is that of peripneumony, and is therefore called the *crepitant* rhonchus; it exactly resembles the sound produced by rubbing slowly and firmly between the finger and thumb a lock of one's hair near the ear. We believe that this sound depends on the forcible passage of air through a little viscid mucus in the finest tubes, narrowed by congestion and deposit around them, but we shall have occasion to investigate this subject under the head of PNEUMONIA.

Of all these different rhonchi, we may repeat what we said of the morbid sounds of respiration, that they may occupy the whole of the respiratory movements, or be confined to part of them. Thus, an obstruction which is sufficient, at the commencement of inspiration, to cause a rhonchus, may be insufficient when the tubes are dilated by the distension of a full breath, or there may be the converse; an obstruction which is total in low degrees of respiration and stops all sound, in forced or extensive efforts, as in coughing, occasions a rhonchus. This suggests to us the propriety of using these different degrees of respiration to test the nature and extent of bronchial obstructions. It may also be inferred from what has been said, that the different stages and degrees of force in respiration may change the note of the different rhonchi, and thus produce such a variety as that which we hear in the chests of some catarrhal and asthmatic patients. Laennec used to call this combination of piping sounds rhonchus *canorus*. It may be readily conceived, too, that these several rhonchi may be variously combined, or exist at the same time in different parts of the lung, and give rise to numerous combinations which it is needless to dwell on. It has been stated that the loudness of a sonorous or sibilant rhonchus is no proof of the severity of the disease; nor is the fact of its being audible over the whole chest, unless the respiratory murmur be at the same time absent or very feeble in parts. But the presence of the bubbling or crepitant rhonchi does imply mischief proportioned to its extent; and if they are heard over a large space, and accompanying the whole act of respiration, diminishing or destroying the natural murmur, they denote disease of a very serious character, because, as our hearing informs us, there is an obstructing liquid in the tubes where there ought to be only air, and the function of respiration must be injured in proportion.

Auscultation of the voice. We now proceed to examine another class of sounds — those of the *voice* as transmitted through the chest. We have found that the sounds of respiration, which are chiefly produced by air passing in the lungs, are transmitted to the air on the surface of the chest. In like manner the sounds of the voice, which are strongly communicated to the same air, are transmitted modified by the size of the tubes, and the nature of the substance through which they pass; and thus these sounds also become signs of the condition of the organs that transmit them.

On applying the ear to the throat or upper part of the sternum of an individual whilst he is speaking, the voice is heard so loud that it seems as if he were speaking into the ear, only the articulation is not so distinct. The reason of this is obvious: the sound of the voice, although originating in the vibration of the glottis, is propagated to the air above and below it; that below, being pent up, is not heard without bringing the ear into contact with the parts where the tubes run, and it there resounds with all its force. This is called *tracheophony*, or the natural tracheal voice.

But when the trachea divides and subdivides, there is not only a division of the sound into smaller tubes, and a consequent diffusion of it and reduction of its strength, but at this division the tubes plunge into the spongy tissue of the lung, which, as we have before found, is a bad conductor, and tends to stop the sound. Hence over the chief bronchial ramifications, as on each side of the upper part of the sternum, at and between the scapulæ and in the axillæ, the voice is still heard, but more diffused and distant than at the throat and sternum, and the articulation is still less distinct. This is natural *bronchophony*, or bronchial resonance.

In other parts of the chest, as the voice gets into the finer tubes with their more flaccid coats and minute cells, its vibrations are either choked and destroyed, or in some parts they may be transmitted across the tissue to the parietes in merely an obscure diffused fremitus. This may be called the *pectoral fremitus*, or *vibration*. It may also be felt by the hand applied to the chest. Before describing the modifications of these sounds by disease, we must notice some natural varieties and their physical causes.

Natural bronchophony, or the vocal resonance in the bronchial tubes, is most distinct in thin persons with a high or treble voice, as in females and children: shrill or treble notes penetrate further into the small tubes, because their vibrations are less extensive, and need less room than those of deeper tone. This may be understood on observing the different vibrations of the cords of a musical instrument: the motions of the treble cords are short and quick, so as to be scarcely visible, whilst those of the bass are long and quite distinct. So in a person with a bass voice, the sound will hardly pass into the subdivisions of the tubes, and there will be little or no bronchophony: but if the voice be strong, it will not be entirely lost, for it will pass across the whole spongy tissue, and throw it all, more or less, into a diffused vibration, which may be heard and felt in many parts of the chest in the character of pectoral fremitus. We find, then, that treble tones give more of bronchophony, and bass ones more of the pectoral fremitus. The same occurs with the morbid sounds; and if we can get our patients sometimes to change their tone of voice, we may thereby more effectually test the condition of their pectoral organs.

Now, as with corresponding varieties of respiratory sound, so with these sounds of the voice, they become signs of disease when they are heard out of their proper places. To know what these proper places generally are, it is necessary to study the anatomical disposition of the tubes, and tissue of the lungs in the different regions. But there is another standard more applicable to individuals, viz. comparison between the two sides of the chest. As there is an approach to symmetry in the structure of the two sides, so there is, in health, a general correspondence between their sounds; and as disease scarcely ever affects both sides at the same time in the same degree, it will make the phenomena of one side to differ from those of the other. For example, if under one clavicle the voice resound loudly, whilst it is scarcely heard under the other, it is certain that there is some physical difference between the two sides that does not exist naturally; or if below the third rib in front there be heard the tubular or bronchial voice, which is generally confined to the immediate neighbourhood of the large bronchi, it may be inferred that there is an altered condition of the parts. Let us inquire what alterations will change the natural disposition of the sounds.

An increase in the density of the pulmonary tissue by a solid or liquid effusion, or even extensive sanguineous congestion in it, will improve its conducting power, and enable it to transmit from the bronchial tubes the vocal sounds which they receive from the trachea. This is *morbid* bronchophony, and it is usually accompanied with bronchial respiration. If, then, the voice be heard resounding in a part of the chest where it is not usually heard, it may be suspected that the lung is in some way increased in density; but this is not certain until it be tested by further means, for there is another change which may also increase the vocal resonance of a part. If, instead of the sound being better conducted from within, it is increased in strength and extent by an enlargement of the bronchial tubes, it may then be heard in situations where it does not naturally reach the walls of the chest. In both cases it may more or less resemble the natural bronchophony heard near the top of the sternum, and between the scapulæ; but it often presents considerable modifications. Thus, when transmitted from the middle-sized bronchi, it comes rather as *diminutived bits of voice* than as articulate words; and for reasons before mentioned, low tones are not transmitted; so that if the patient varies his cadence,

some words are heard and others not. When arising from dilated air-tubes, or when transmitted from the larger tubes, the resonance is more noisy and continued, varying less with the tone of the voice. If the air-cells over the resonant tubes be still open, the sound will be diminished when they are dilated by a full inspiration, because they then tend to intercept it more. The loudest bronchophony is caused where the middle and upper lobes of the lung are pressed against some part of the walls of the chest by a liquid effusion in the pleura, which cannot displace the lung from that part, because it is bound to it by old adhesions.

But what modifies the transmitted voice in the most remarkable manner, is a thin layer of liquid between the lung and the walls of the chest. The liquid is thrown by the vocal resonance of the lung into a state of irregular vibration, which causes it to transmit the voice in a broken tremulous manner, so that it sounds to the ear outside like the bleating of the goat. Hence Laennec called it *ægophony* (αἰγὸς φωνὴ). It may be produced simply by liquid in the pleural sac, without disease of the lung; for the compression of the pulmonary tissue caused by the liquid is enough to enable the lung to transmit the voice from the bronchial tubes within it. When the lung is consolidated also by disease, the vocal resonance is stronger, and there is a loud bronchophony mixed with the bleating voice, constituting a kind of double or buzzing voice, which Laennec compared to that performed in the exhibition of *Punch*.

There is yet another kind, which may be called the perfection of vocal resonance in the chest. When a cavity is formed in the lung by the emptying of a vomica or abscess through the air-tubes, the voice passes from these tubes into it; and if the communication be free, the voice may, by the ear applied outside, be heard in the cavity as distinct as it is in the trachea. This is *pectoriloquy*—not only voice, but speaking in the chest. When the cavity is near the surface, of moderate size, and opens freely into a large air-tube, the phenomenon is most perfect, and then sounds exactly as if a patient spoke into the ear: this is limited to the spot where the cavity lies, which is thus, as it were, a little island of voice, and is a sure sign of a cavity. The sound of bronchophony is often louder, but then it is more diffused, and there is less distinctness in the words. We shall enter further into these distinctions when we treat of the lesions of which they are signs.

When the cavity is large, and the opening into it small, the voice may not fully enter it; but there may be a tinkling or hollow reverberation in it, like that in a phial. This is an echo modified by repeated reflection, and constituting a separate note. It is called *amphoric resonance*, or *metallic tinkling*, according to the character of the sound. It may be produced in the cavity left by a large vomica or abscess, or by several of these running together; but its more common seat is the sac of the pleura, into which the air has entered through a fistulous opening from the lung. This being the resonant or echoing cavity, it is plain that not the voice only, but the breathing and cough also, especially if they be accompanied by a bubbling through the fistula, will have more or less of this tinkling or bottle sound.

Besides these various positive phenomena of the voice, the absence of the *vocal fremitus* is sometimes a valuable sign. It has been stated that this pectoral fremitus can be felt as well as heard. On applying the hands, one on each side of a healthy chest, the vibrations may be felt nearly alike on both sides. Liquid in the pleura will generally more or less destroy this fremitus; and the difference which it produces between the two sides is often a very valuable sign of the presence of liquid. Consolidation of the lung, again, will increase the vibrations, or make them even stronger over the bronchial tubes. In cases where one side is quite dull on percussion, we may often thus easily distinguish whether the dulness is caused by consolidated lung or liquid in the pleura, which is a point of great importance.

Besides the sounds produced by air and the voice, there is sometimes one produced by the motion of the lung against the ribs. The lungs, although

they nearly follow the motions of the chest, do not move quite with it, especially in the lower parts, where the descent of the diaphragm draws the lungs downwards whilst the ribs are rising. But in the natural condition the surfaces of the pulmonary and costal pleura are so smooth, and so well lubricated with serum, that although there is motion, there is not resistance enough to that motion to cause sound. But if these surfaces become uneven by the deposit of rough matter on them, or by an irregular distension of the tissue by solids or air under them, there may then be a rubbing sound with the motions of respiration; this occurs in pleurisy and emphysema of the lung. This rubbing sound is often the more evident in these cases, because the same disease, by preventing the proper expansion of the lung, causes less harmony than usual between its motions and those of the chest.

The foregoing description of the acoustic phenomena of the chest connected with respiration may perhaps be considered rather minute, and it is hardly expected that the student will be able easily to master all the details; but if sufficient attention be paid to the principles that have been explained, the various phenomena which are illustrations of these principles will become familiar and intelligible when they present themselves in clinical experience. In the descriptions of individual diseases we shall again meet with these phenomena; and by the principles which have now been explained, we shall be prepared for them wherever they may occur. The subjoined tabular view of the chief phenomena of auscultation of the organs of respiration, may give additional assistance.

SOUNDS PRODUCED BY THE PASSAGE OF AIR IN RESPIRATION.

Sound of Respiration. — *Natural; produced by collision of the air against the sides and angles of the air-tubes.*

Tracheal; heard in the neck and at the top of the sternum.

Bronchial; near the upper parts of the sternum, between the scapulæ, &c.

Vesicular; in most other parts of the chest.

Morbid, modified in production or transmission.

Bronchial, or whiffing; transmitted from the bronchi by condensed tissue of the lung.

Cavernous, Amphoric } produced in morbid cavities communicating with the bronchi.

Rhonchi, produced by increased resistance to the air moving through the lungs.

Dry;	Sibilant, Sonorous, Dry mucous	produced by viscid mucus in the bronchi, or by swelling of the membranes, or by pressure upon them.
Moist;	Mucous	produced by a bubbling passage of air through liquid in the bronchi.
	Submucous	a liquid in the finer bronchi.
	Subcrepitant	liquid in the smallest bronchi.
	Crepitant	viscid liquid in compressed smallest bronchi.
	Cavernous	liquid in a morbid cavity.

SOUNDS OF THE VOICE TRANSMITTED THROUGH THE CHEST.

Natural Sounds, *heard in a healthy chest.*

Tracheophony, in the neck and at the top of the sternum.

Bronchophony, near top of the sternum, between the scapulæ, in the axillæ, &c.

Pectoral fremitus, in many parts of the chest.

Morbid Sounds, transmitted or produced by a diseased chest.

Bronchophony, transmitted by condensed pulmonary tissue.

Ægophony, the same vibrating through a thin layer of liquid.

Pectoriloquy, resounding in a cavity in the lung.

Tinkling, a changed echo of the voice or cough in a large cavity.

SOUNDS PRODUCED BY THE MOTIONS OF THE LUNGS.

Sounds of friction, when the pleuræ are dry, or rough from deposits.

Emphysematous crackling, by the irregular passage of air between the lobules.

We shall now describe shortly the methods of auscultation or the means which we use to obtain a cognisance of those acoustic phenomena which we have

found to be signs of the condition of the organs within the chest. We have already described the methods of percussion; and we have now to study the best mode of listening to the signs of the motions of the chest. All these signs can be heard by the direct application of the ear to the chest, and this *immediate* method of auscultation is so easy and simple, that it commends itself strongly to us, and in many cases is used with advantage. The sounds proceeding from the walls of the chest are communicated to the ear, and especially to the air contained in the external meatus, and are thus propagated in the most direct and unmodified manner to the organ of hearing. *Immediate* auscultation is exclusively practised by some, both at home and abroad; and as it is much more easily learnt than the *mediate* method, it will probably always have its advocates among those who prefer ease to exactness. But if we can hear the signs so well by the unassisted ear, it may be asked, what is the use of the *stethoscope?* We shall first mention some positive objections to immediate auscultation; and on examining the principles of the stethoscope, we shall find that it has, in many cases, considerable positive advantages. To apply one's ear, and therefore the nose, face, and so forth, to the chest of a patient who is dirty, blistered, or wet with perspiration, would be disgusting. To apply it to the chest of a patient labouring under an infectious disorder would be unsafe. To apply it to the person of a young female would scarcely be delicate. Moreover, it is difficult to apply the ear well to some parts of the chest, such as the armpit, and below the clavicles or between the scapulæ in thin persons. Besides this, disturbing noises sometimes arise from the contact of one's hair or clothes with the patient's chest; and unless the practitioner's neck be pretty long and flexible, this easy method will be found, after all, more fatiguing than the mediate method; still, in a great many instances, it may be used with advantage, especially in examining the regions of the back, and in children where the stethoscope might cause alarm, and could not be so steadily or quickly applied.

We want an instrument, then, to transfer the sounds from the chest to our ear, which must be a good conductor of sound; and as the power of bodies to conduct sound depends on the strength and uniformity of their elasticity, and their capacity to vibrate like the body that produces the sound, we must have an elastic material, of density resembling that of the sources of sound within the chest, and of the walls of the chest through which they are transmitted. But the sources of the pectoral sounds vary: some, as the voice and respiration, or at least the hollower sounds of respiration, are produced in air; whilst in others, such as the sonorous rhonchus, the rubbing sound, and the sounds of the heart, the solids are chiefly concerned: we shall therefore need a varied capacity in our instrument to receive these sounds. It should be a uniform solid, and the lighter it is the better, provided it be thoroughly rigid. Now nothing answers to this description so well as wood; and in the light kinds of wood with a stiff longitudinal fibre, such as pine-wood, deal, cedar, and the like, we find these qualities in perfection: through a cylinder of such wood, about eight inches long, and an inch and a half in diameter, adapted to the ear at one end, most of the pectoral sounds may be heard; but those best which originate in solids, such as the sounds of the heart, of friction and sonorous rhonchi. The sounds of respiration and of the voice are also heard through it, but not nearly so distinctly as with the naked ear.

We need, therefore, an aërial conductor for these sounds, because they originate in air, and can best be transferred through air. By perforating the cylinder with a bore a quarter of an inch in diameter, it becomes a tube through the column of air in which the respiration and voice may be heard with increased distinctness. But as this column of air is in contact with only a small spot of the chest, it can transmit only the sounds produced under or very near that spot, and the instrument thus prepared is well-adapted for the exploration of small parts of the chest. But we want the instrument also to transfer the sounds of larger spaces: the sounds of so limited a space are often too weak to be heard alone; and besides, it would be very tedious to go over the whole

chest, *dotting* in this way a quarter of an inch at a time. Now, if the column of air be enlarged at the base where it is in contact with the chest, by hollowing out the wooden cylinder into a funnel shape, it will conduct the sounds produced on this greater extent of surface, which are reflected by the funnel into this central bore, and conveyed concentrated to the ear. This also gives the instrument the power of concentrating or magnifying the sounds; they are thus heard as strong at the distance of several inches or even a foot or two from the chest as they are to the ear in close contact with it; nay, in some cases they are even stronger. The best shape for the excavated end is that of a long funnel or cone, with its apex terminating in the central bore; for this directs the sound at once in the right direction without repeated reflexions, which may modify it. As we still sometimes want to explore small spots of the chest, by means of a perforated plug the excavated end can be filled and the instrument reconverted into a simply perforated cylinder. To make the instrument more portable, the upper part of the cylinder may be reduced to a stem half an inch or less in diameter, leaving only at the top a sufficient width for the ear; or this top may be made of a harder wood, or of ivory. Wood is so excellent a conductor of sound, that when once the vibrations are in it, they can be conveyed by a very small body of fibres.

Thus the stethoscope, although a simple instrument, performs several offices in relation to sound, the chief of which may be enumerated as follows: 1. To conduct sound by its solid walls. 2. To conduct and concentrate sound by its closed column of air. 3. To transfer sounds from its column of air to its solid walls, or the converse, when circumstances impede their transmission by one of these ways. 4. To diminish this power of transfer, and contract the field of hearing when small spots are to be explored.

We have now only to add a few words on the method of using the stethoscope. It is quite necessary that the instrument should be applied in close contact with the chest and the ear; the least tilting uncloses the column of air, and occasions great loss of sound outwardly as well as a confusing entrance of extraneous noises. To prevent this tilting, it is best to hold the stethoscope by its pectoral end firm on its base, and then to apply the ear flat on the top. If the inequalities of the ribs leave chinks between the chest and the instrument, a fold or two of linen will fill these, or the stethoscope may be used with the stopper in. For the sounds generally, it is better to use the instrument without the stopper; but when it is an object to determine, whether a sound is produced in a limited space, or over some extent of surface, the circumscribing power of the stopper is wanted. Thus it is often of importance to determine, whether a local resonance is produced in a small cavity, or merely transmitted by consolidated lung from several bronchial tubes distributed over some extent of surface. The simply perforated cylinder will often do this by showing the size and shape of the limited spot in which the resonance or pectoriloquy of a cavity can be heard in its full strength, while the bronchophonic resonance is transmitted less strongly and may be traced over some extent of surface, generally in the known direction of these tubes. The stopper is also useful in shutting out the sound of respiration, when it is an object to listen to the sounds of the heart or arteries, and in many other circumstances which will be noticed in the history of special diseases.

In conducting physical examination, due care should be taken to avoid fatigue or annoyance to the patient. There are cases in which a complete physical examination will do more harm than the information which it may bring can do good; but they are few, and it must be left to the discretion of the practitioner to hold the balance between too much and too little examination. Experience soon points out that the observer must also consult his own ease in the act of auscultation; for a constrained or painful posture impedes the hearing and disturbs the attention. For this reason, it is sometimes easier to hear with a flexible ear-tube than with the straight stethoscope, although the latter is by far the best instrument for general purposes.

II. Examination of the Chest through the Vital Properties or Functions of its Organs. — Analysis of the General Symptoms of Diseases of the Chest.

We have been hitherto occupied in considering the *physical* properties of the chest and its organs, and the manner in which these properties may become signs of the condition of these parts. We have now to examine them through their *vital* properties, which, combined with certain physical and chemical powers, constitute *function*. Physiology teaches us that the elementary vital properties immediately concerned in the function of respiration, are sensibility and contractility, to which may be added, the power of secretion. These properties are closely linked together with the chemistry and mechanism of the organs of respiration, so as to constitute their healthy function. Any excess, defect, or disorder, of any of these properties, will be more or less felt throughout the links of this chain, and hence may arise not only derangement of the function of respiration, or *dyspnœa*, but also new phenomena proceeding from a loss of due balance of the same properties, such as *cough*, *expectoration*, and *pain*; and linked as the vital properties are with those of other organs, there may be added disorders of these in the form of disturbance of the circulation, and its sign the arterial pulse, general fever, disorder of the secretions of the kidneys, liver, and intestines, and of the digestive, nutritive, and sensorial functions. The phenomena arising from these several disordered properties are what are called the *vital* or *general symptoms* of disease, which we now have to consider in relation to the organs of respiration.

It may be inferred, and will be more apparent as we proceed, that these general symptoms, dependent as they are on such a linking together of many properties, the laws of which are but imperfectly understood, must be far less simple and intelligible than the physical signs; and the variable measure of the vital properties also renders general symptoms far more uncertain than these signs, in their degree, and even in their presence. We cannot with any certainty, as with the physical signs, from a knowledge of the phenomena, and the laws which regulate those phenomena, deduce the condition of the parts which produced them, nor, from knowing the condition of parts and physical laws, deduce what phenomena the parts ought to develop. For example, the solids of the body have sensibility, which varies not only in different parts, but in the same parts at different times, and this for reasons which we cannot discover; therefore we cannot calculate on it. The contractility of moving parts also varies in a similar manner; and we can by no means gain, from the character of their motions, a criterion of their true condition. Instead, therefore, of pursuing the synthetic as well as the analytic method, which we have done with regard to the *physical* examination of the chest, we shall shortly analyse the chief *general symptoms* of diseases of the chest, and by that examination endeavour to determine their nature and varieties, and their value in teaching us to discover, to measure, and to treat these diseases.

Dyspnœa, difficult or disordered breathing, is the most important general symptom of disease of the chest, inasmuch as it implies some interruption to the due performance of some part of the great function of the chest — respiration. Dyspnœa may be caused by circumstances affecting any one or more of the several elements concerned in the function of respiration, viz. the blood in the lungs, the air, the machinery of respiration by which these are brought together, and the nervous system through which the impression which prompts the respiratory act is conveyed from the lungs to the medulla oblongata, and thence to the muscles which move the machinery; in fact, all the causes which in excess produce asphyxia, in slighter degrees occasion dyspnœa. Subjoined is a table which exemplifies these causes of dyspnœa; but the character of the symptom itself must first be described.

When any thing interferes with the sufficient action of the air on the blood,

the impression which prompts the acts of breathing not being relieved, causes a quicker and fuller repetition of this act, and if the interference still remain, the breathing will continue to be more or less hurried and forced, until the sensation or impression is reduced to the ordinary standard of almost unconsciousness. An individual in whom the breathing is hurried may not be sensible that it is accelerated; whilst in another who feels the oppression, there may be little appearance of shortness of breath. Again, the feeling of dyspnœa must greatly depend on the condition of the sensorium; for whilst some patients are conscious of the slightest infringement on their respiration, others, particularly in congestive fevers, are brought to the verge of asphyxia without complaining of any oppression. So, too, we are sometimes astonished to find, on opening the bodies of the dead, a whole lung diseased, or one side of the chest full of serum, where the patient had not complained at all of dyspnœa; while, in other cases, a much smaller lesion of the organs has been attended with the most distressing orthopnœa. It is, however, rather to the sensation of breathlessness than to merely accelerated breathing, that the word dyspnœa is generally attached; for, translating it as difficult breathing, this expression can be hardly applied when the difficulty is overcome by accelerated movements of which the patient may not be conscious. But we shall here advert to frequency of breathing, as well as the feeling of dyspnœa.

The number of respirations in a healthy adult male at rest, generally ranges about twenty in a minute. It is more in children and in females, and it becomes increased in all cases, not merely from affections of the lungs or connected organs, but also from general weakness or depressing causes, which, diminishing the strength of the muscles of respiration, oblige them to make up by the frequency of their contractions what is wanting in their energy. Probably there are some nervous conditions of the system also, in which the breathing becomes accelerated, from what Cullen called *mobility*, a greater readiness to move than power to complete the motions. We have seen the breathing hurried in some cases of hysteria, without the patient being conscious of it, and without either real weakness or pectoral disease to account for it. These cases are of no consequence in themselves, but should be known, that they may be separated from those of true dyspnœa. In many other cases, especially those, we believe, where the nervous system is affected, the breathing is not accelerated, but suspirious, a sigh or deep breath being taken from time to time; yet the patient is often not conscious of any oppression or unusual effort. This may be called irregular breathing, and there are several other varieties, which we have not time to consider in detail. The rhythm in breathing probably depends entirely on the chain of influences which we before described as concerned in the act, and not on any peculiar periodicity, such as that which seems to reside in the heart; and therefore irregular breathing must depend on a change in one or more of the links in that chain.

The feeling of dyspnœa is one of a very peculiar and distressing character. Even when slight in degree, its permanent oppressive influence is very wearing; and when severe, it causes the most indescribable suffering, with such a feeling of impending death, that the most courageous are often unmanned by it. The constrained postures of the patient, the anxious or even desperate expression of his countenance, the painful straining of all the muscles that can in any way, however distantly, assist in the respiratory movements, bespeak the intensity of the feeling, which is far worse than the most acute pain. It is worthy of remark, however, that this feeling is experienced in its severest degrees only by those in whom the dyspnœa comes on rather suddenly, especially when the sensibility is entire, and the lungs are not diseased, as in obstructions in the trachea or large bronchi, spasm or swelling of the glottis, and spasmodic asthma. In these cases the sensibility is not gradually blunted by the circulation of imperfectly oxygenated blood; nor has the activity of the functions, which require arterial blood, been lowered by previous depressing causes. Opium, belladonna, camphor, and other narcotics, will sometimes relieve the

symptoms of dyspnœa, not only by deadening the sensibility, but also by diminishing the activity of those functions and secretions which require oxygenated blood, and therefore a free supply of air. If we could temporarily produce a state approaching to the torpor of hybernating animals, we might diminish the bad effects, as well as the painful feeling of dyspnœa; and we believe that such a state is actually induced in those who are habitually asthmatic, in whom all the functions are brought to a lower standard, and who thus suffer with impunity such an encroachment on the function of respiration as would be fatal to an individual of a common standard.

The feeling of want of breath has been used as a means of testing the condition of the respiratory organs. A person whose respiration is free and unembarrassed, can hold his breath longer than one whose lungs are diseased. Dr. Lyons has proposed to measure the condition of the lungs by the time which he can *hold the breath*, after a full inspiration; and to insure accuracy, the patient is desired to count numbers during this time. A healthy person with a good chest can continue counting for forty-five seconds without taking breath, whilst those with diseased lungs often cannot keep on for twenty seconds. The same objection may be made to this test that we made to the measuring of the exhaled air proposed by Mr. Abernethy, that it is a test as much for the strength of the muscles of respiration as for the condition of the lungs. Besides, both the feeling of want of breath, and the power of augmenting the respiratory movements, vary considerably in different healthy subjects. It is well-known that divers acquire the power of remaining under water for two or three minutes (it has been said more) without taking breath. In diving animals there is a structural provision to enable them to continue some time without air. The chief venous trunks are very tortuous, and admit of dilatation, so that the venous blood can accumulate in them, instead of distending and embarrassing the right cavities of the heart and the lungs. Perhaps some change of this kind may be somewhat produced in divers by the often repeated practice of holding the breath. Professor Faraday has described another mode by which a person may be enabled to hold his breath for a minute and a half, which is double the time usually practicable. This is by making in succession five or six full and forcible inspirations, which seem to so completely change the air in the lungs, that there is left in them a stock of pure air capable of lasting during that time. The knowledge of this fact may be useful, if ever it is wanted to hold one's breath for a time in going into the suffocating atmosphere of a sewer, a mine, a house on fire, or the like, or in diving.

Dyspnœa is often a symptom demanding great attention in diseases of the lungs; but it must be studied in conjunction with the other general symptoms and the physical signs, for in itself it is most vague and inconclusive. This may be perceived on inspecting the subjoined tabular view of the causes of dyspnœa, which is founded on the physiology of respiration. This table deserves attention, not only in showing the varied nature and origin of the symptom, but also in contrast with the tables of the physical signs, the causes of which are much less varied, and far more appreciable. But when, through the means of the physical and other general symptoms, it has been made out on what cause the dyspnœa depends, then this symptom often becomes a valuable measure of the increase or diminution of the disease, and a useful guide of practice.

PROXIMATE CAUSES OF DYSPNŒA, OR DIFFICULT BREATHING.

1. BY IMPEDING THE ACCESS OF PURE AIR TO THE LUNGS.

a. *Mechanical.*

Rigidity of parts of the respiratory machine	*e. g.*	Ossification of cartilages; induration of the pleura; rickety distortions.
Pressure on ditto	*e. g.*	Tumours or dropsies of the abdomen.
Obstructions of the air-tubes	*e. g.*	Effusions in, swellings of, tumours pressing on, the air-tubes.
		Spasm of the glottis; spasm of the bronchi.

- **Compression of the lungs** — *e.g.* Effusions or tumours in pleural sac — Pleurisy, Hydrothorax, Pneumothorax, Aneurism, &c.
- **Alterations in the tissue of the lungs** — *e.g.* Engorgement of the vessels. Effusions — Œdema, Hepatisation, Tubercle, &c. Altered structure — Emphysema, Dilated bronchi, Vomicæ, &c.

b. *Chemical.*

- Deficiency of oxygen in the air — *e.g.* Mephitic gases; rarefied air.

c. *Vital.*

- Pain of parts moved in respiration — *e.g.* Pleurodyne; pleuritis; peritonitis, &c.
- Paralysis of muscles of ditto — *e.g.* Injuries of the spinal marrow in the neck, &c. Paralysis of the bronchi (?).
- Weakness of ditto — *e.g.* Excessive prostration from ataxic fevers, &c.
- Spasm of ditto — *e.g.* Tetanus; spasmodic asthma, &c.

2. By the state of the blood.

a. *Mechanical.*

- Obstruction to the passage of the blood — *e.g.* Diseases of the heart and great vessels; tumours pressing on them.

b. *Chemical.*

- An excessively venous state — *e.g.* Violent exertion; idiopathic dyspnœa (?).
- Deficiency of red particles — *e.g.* Anæmia; chlorosis.

3. By the nervous relations of respiration.

- Excessive sensibility of the par vagum — *e.g.* Hysteric dyspnœa; cerebral fevers; neuralgia (?).
- Defective ditto — *e.g.* Coma; narcotism, &c. (breathing slow).

Cough. Another symptom, which is even more common in diseases of the chest than dyspnœa, is *cough*. The act of coughing consists in one or more abrupt and forcible expirations, accompanied by a contraction of the glottis, trachea, and upper bronchial tubes. The expirations being more complete than usual, especially when there are several of them, are followed by a deep forcible inspiration, the force of which is shown by the loud respiratory murmur, which, by the ear applied to the chest, may be heard to accompany it. The muscles chiefly concerned in the act of coughing are the abdominal muscles and intercostals, the combined contraction of which effects a strong pressure on the contents of the chest.

The common cause of cough is phlegm, or some other matter irritating the air-passages, and the object or final cause of the cough is to expel or expectorate this matter. The proximate cause of cough may be said always to be some irritation, either direct or by sympathy, of the sentient parts of the air-tube, or of the nerves which render them sentient. Some parts of the bronchial membrane are much more sensitive than others; that lining the glottis and larynx is excessively so, and the least irritation of it is enough to excite coughing. That of the trachea and large bronchi is less, for foreign bodies have been known to lodge in them for some time without causing any coughing, so that some have supposed that they have nothing to do with the production of this symptom; but when the sensibility of these parts is increased by inflammation or nervous excitement, any thing irritating them will also excite coughing. It is easy to see why the sensibility of the air-tubes should be greatest at their entrance; it is the *door-keeper*, placed there to exclude, or, by calling other forces to its aid, to expel any thing improper which may intrude. But the other parts of the tubes have also a preserving sensibility, which may bear a little, but is soon roused into activity by continued irritation. We find the parallel of this in the alimentary canal in the natural state. The sensibility that excites the action of vomiting is peculiar to the fauces at one end of the tube; and that which induces the striving of defæcation resides chiefly in the termination of the rectum at the other end: but uncommon degrees of irritation, or an exalted sensibility, will occasion the same actions

to be excited by impressions on other parts that are usually insensible: hence arise the vomiting caused by an over-irritated or inflamed stomach or duodenum, and the tenesmus and purging excited by a similar state of the colon. We shall see this more fully on considering the various causes of cough.

As other irritations, cough may be excited either by an unusual irritant acting on the tubes in their natural state, or by the ordinary circumstances, which, although not usually irritating, yet become so by the exalted irritability of the tubes, or, as is the more common case, by a combination of these causes. We have an example of cough excited simply by an unusual irritant, when a portion of food or of bronchial mucus lodges on the membranes of the glottis; and an irritant may act by sympathy as well as by direct application, as when we excite coughing by introducing a probe pretty far into the ear. The cause by increased irritability is exemplified in the cough of early bronchitis and nervous asthma, which the mere inhalation of air is sufficient to excite. There are both an unusual irritant and increased irritability, in the secreting stages of bronchitis and other affections, where an unusual quantity, and sometimes an irritating kind, of mucus is poured out on an over-sensitive membrane. This more complex cause of cough is frequently induced by the continuance of the other causes; thus, the continued application of an irritant will develop an increased sensibility; and increased sensibility and irritation will be followed by inflammatory excitement and the secretion of matter, the quantity and quality of which add to the irritation. Thus we see how the physiological causes of cough become identified with the pathology of bronchitis, or inflammation of the membrane of the air-tubes; and in common parlance, a bronchial inflammation is called a *cough*, this being the most prominent symptom. But although this inflammatory condition is often developed by the continuance of causes which produce cough, yet it is not necessarily so, and there may be irritation or increased sensibility, or both, enough to cause cough, and which may yet be short of the degree or the conditions requisite to produce inflammation.

It has been stated that the irritation which causes cough may not be applied to the bronchial membrane itself, but may be exerted from a part more or less distant. Thus cough may be excited by tubercles in the parenchyma of the lungs, by inflammations or irritations of the pleura, peritoneum, stomach, liver, and so forth; and although we may conjecture that these irritations are conveyed through the nervous branches which connect these several organs and the air-tubes with one common sensitive centre, yet we cannot explain why they should be sometimes conveyed, and at others not; for although cough does frequently accompany the pathological conditions to which we have just adverted, yet irritations and inflammations of the stomach, liver, peritoneum, nay, sometimes even of the pleura and pulmonary parenchyma, often arise without any cough whatever. It has been attempted to explain these discrepancies by assuming that there must be bronchitis present to produce cough, and that, when these several distant irritations do not excite bronchitis they are unaccompanied by cough; but this view increases instead of diminishing the difficulty, for it leaves unexplained the reason why this supposed bronchitis should occur in some cases and not in others; and bronchitis, although including cough, is more than cough, and needs something more to produce it. We may conjecture about local weaknesses, constitutional peculiarities, and irregular sensibilities, as causes of these differences, and this is all that we can do towards explaining them: but this is not what an explanation ought to be; this is referring phenomena not to known general properties, and the laws which govern them, but to individual peculiarities and undefined influences, the laws of which are not known. These considerations furnish another proof of the uncertainty of general symptoms as means of diagnosis. Still, when cough does occur, and its cause has been made out by the aid of other signs, it deserves attention, not only as a symptom, but as a morbid action of a distressing and hurtful kind, which sometimes may require remedies expressly to relieve it.

This illustrates what has been said before, that general symptoms, although much less constant and instructive than physical signs with regard to the diagnosis of organic lesions, yet, when positive, often tell us more of those general conditions of the system, which become our guides in the employment of remedies.

Under this impression we shall examine some of the varieties of cough which present themselves in different cases, and trace the connection between their characters and variations in the elements that constitute them. Of course the study of a symptom in any individual case must be conjoined with a proper survey of its functional or organic cause; but as we have also (sometimes only) to treat the symptom, it is highly useful to study its varieties, and thus to render it more practically instructive.

The cough may vary according to, 1. The irritant exciting it; 2. The sensibility feeling the irritation; 3. The movements thereby excited, which consist of (*a*) the contraction of the muscles of respiration, and (*b*) the contraction of the air-tubes; 4. The condition of the bronchial membrane and its secretion.

Under these heads, we shall meet with the varieties of cough with which every practitioner is familiar.

1. The violence of a cough will, *cæteris paribus*, be in proportion to the degree of irritation that excites it. For example, a healthy person whilst eating or drinking incautiously, suffers some food to enter the glottis; the cough thereby excited will be more severe with wine or any thing peppered, than with water or any bland food. So in the early stages of catarrh, although the sensibility of the membrane is increased, yet the thin saline-tasted secretion also acts as an unusual irritant upon it, and keeps up a short teasing tickling cough, with continued attempts to clear the throat. When the irritation is more moderate, but irremovable, like that occasioned by incipient tubercles in the pulmonary tissue, the cough will generally be of that slight *hacking* kind, with little or no expectoration, that is so well-known as one of the first symptoms of pulmonary consumption. The irritant here remaining the same, the circumstances which increase this cough are those that augment the sensibility of the lung and air-tubes, such as a quickened state of the circulation from exertion, heated rooms, or during the assimilation of stimulating food.

2. We have already adverted to increased sensibility as being concerned in the cough of recent bronchitis or bronchial irritation. It becomes, however, more developed when the cough has lasted several hours, and instead of being short and tickling only, it comes on in more violent and prolonged fits, which are quite irresistible, and often accompanied by a feeling of soreness. The heightened sensibility of the air-tubes is further manifested by the readiness with which breathing air at all cold, or swallowing any thing at all irritating, will excite cough. We have before remarked how this increased irritability of the inflamed air-tubes is commonly joined with the augmented irritation of their secretion; but we do sometimes meet with cases in which the increased sensibility is purely nervous, unaccompanied by any secretion; and the cough is brought on by the slightest cold or irritating matter in the air. Even strong odours will sometimes cause it. These nervous coughs are to be treated chiefly by various remedies which diminish the sensibility of the nervous system, such as narcotics, or sometimes by those which excite stronger impressions in other parts, such as epispastics and the application of heat.

3. Besides the sensibility of the bronchial membrane, another property connected with the nerves, muscular mobility, may be the source of some varieties of cough. We cannot here examine the circumstances under which a change of proportionate relation takes place between the action of the motory nerves in general, and the impressions which excite them. It is sufficient for us that the fact is well-known, that in certain conditions or states of the system, an ordinary impression will excite inordinate motions; while in others the motions resulting from similar impressions will be imperfect, and below the natural amount. It is thus also with the motions of muscles concerned in coughing: they

may be excessively mobile, so that the least irritation will set them agoing; and, like a clock without its pendulum, they continue their impetuous motions, until their strength has fairly run out. This is the *convulsive* cough, which we meet with in some hysterical and nervous subjects, and its convulsive character is the more evident from the fact, that it sometimes alternates with chorea, or convulsive affections of other sets of muscles. The same uncontrollable character is, however, often communicated, by a nervous temperament or peculiar nervous affections, to coughs arising from common causes, which thus shake and exhaust the patient in an unusual degree, and require appropriate modifications of treatment to subdue them. Hooping-cough in its after stages is of this kind, and from our experience we should say, that the shaking uncontrollable nature of the cough is more characteristic of pertussis, than the hooping, which is not always present, especially in adults. This leads us to consider on what hooping depends; and here again we shall find the use of our physiological divisions, which explain some other varieties of cough that are sometimes met with.

In considering the physiology of respiration, we are led to believe that the act of expiration is aided by the contraction of the circular fibres of the air-tubes. In the forcible expirations which constitute ordinary coughing, there is also a simultaneous contraction of the air-tubes, and especially of the aperture of the glottis, through which the air is driven with the greatest force, in order to expel any irritating matter. Now the contraction of these tubes may be excessive, defective, or irregular, and this will occasion other varieties of cough. When their contraction is excessive, being also generally irregular, they give the *wheezing* character to the cough, so remarkable in asthmatic subjects. A wheezing cough does not always depend on contraction of the circular fibres, for other constrictions of the bronchi will also cause it; but if we listen to the chest of a nervous asthmatic, we may often hear, in the forcible expirations of a fit of coughing, sibilant and sonorous rhonchi, which are too transient to be produced by the thickening or secretion of the tubes. Where the irritability of the bronchi is great, their contraction may not, as usual, cease during the act of inspiration; and it is this spasmodic constriction affecting particularly the upper part of the air-tube during the forcible inspiration which succeeds to coughing, that causes the *hooping* sound. This state of things happens chiefly in the irritable frames of children when affected with convulsive cough; and the violence and repetition of the expiratory efforts of this cough occasion the back draught to be the more forcible, sonorous, and prolonged. If we apply our ears to the chest of a child during a fit of hooping-cough, we are surprised to find how little sound we can hear there with all these noisy external efforts; in fact, the continued constriction of the bronchial tubes permits very little motion of air into and out of the tissue of the lungs: in the convulsive cough of adults, again, in which there is seldom hooping, the respiratory murmur of the long inspiration, or back draught, is pretty loud, whilst the succession of coughs here also consists more of external than of internal movement. In all these kinds of cough, antispasmodics will often give more relief than any other class of remedies.

But we may have an opposite condition of the circular fibres of the bronchi, a weakness or deficiency of action, a paralysis, so that they do not contract as usual during the expiratory efforts of coughing. This constitutes the *hollow* or *barking* cough which we sometimes hear in chronic bronchitis, and now and then in febrile and nervous affections. This cough is, as we shall presently find, accompanied with a difficulty of expectoration; hence it is sometimes very distressing, and particularly so when, as it occasionally happens, it is combined with a mobility of the external muscles of respiration, rendering the cough convulsive and paroxysmal. The tearing and exhausting fits of this kind of cough are sometimes quite agonising; and we may judge from the bloated, congested appearance of the lips and face, how much these fits impede the respiration and circulation, and how much they may thus tend to increase and perpetuate

the diseased condition of the bronchial tubes. In some such cases we have seen the terebinthinaceous medicines, with external counter-irritation and occasional emetics, give most relief; but the treatment will depend on various circumstances, which cannot be entered into at present.

4. Besides the sensitive and motory apparatus concerned in the act of coughing, we have the secretion of the air-tubes, which may also by its qualities modify the character of the cough. According to whether this secretion is present or not, the cough may be humid or dry; and according to the relation of the qualities of this secretion to the powers of expectoration, the cough may be loose or tight; and these varieties may be combined with the other species of cough, as those may with each other; and thus are produced the endless host of different kinds of cough that we meet with in practice. Without pretending to affirm, that it is always possible to classify these by the division now pointed out, we may state that we have often found this analysis useful in drawing attention to the predominant changes of vital property, as manifested by symptom, and in thus distinguishing cases which require different modes of treatment.

Expectoration. The expectoration is another symptom of thoracic disease, which must be considered as the result of vital as well as physical properties, and therefore it is included under the head of general diagnosis, although it sometimes approaches in character to a physical sign. The word expectoration strictly means the act of expelling any thing from the chest; but by a figure of speech it is also applied to the matter so expelled. We shall find that both the act and the matter of expectoration may present us signs of the condition of the pectoral organs.

If we consider the structure of the bronchial tree, we shall perceive that natural breathing tends to prevent the accumulation of matters in its tubes, in spite of gravitation. The area of the smaller divisions of the bronchi is considerably greater than that of their trunks; and it may be represented as the divided base of a hollow cone or funnel, which is concentrated gradually in the trunks, and completely in the windpipe. The air, in the more sudden act of expiration, passes with greater rapidity and force as it converges into these trunks, and therefore tends to carry through them any superfluous matter that may be present on the bronchial surface. This will explain how the finer bronchial tubes of the most dependent parts of the lung are, in health, kept clear of any accumulation. Possibly the ciliary motions of the mucous membrane may, as MM. Purkinjie and Valentin have surmised, tend to the same effect.

But it is the forcible acts of special expectoration, *hawking*, and coughing, that tend most effectually to clear the air-passages; and they do this by both increasing the force and fulness of the expiratory effort, and at the same time contracting the upper tubes and trachea, so that the air acts with greater force on any superfluous matter in them. The repeated closure of the glottis in coughing increases the expulsive effort by letting out the air in successive sudden jerks, which are more forcible than any continued act of expiration would be. We see this exemplified in cases where the operation of bronchotomy has been performed. The patient often cannot expectorate effectually so long as air can pass out from the artificial opening, and he is in danger of suffocation in consequence; but on closing this during the act of coughing, the force of the air can be directed in the natural way against the accumulated matter. By attention to this particular, suffocation has been averted in more than one instance after this operation. In certain diseased conditions of the larynx, the patient cannot close the glottis; and hence also expectoration may be difficult, while the cough assumes a continuous uncontrollable character, which we might have added as another variety to those before enumerated. This is what M. Trousseau calls a belching cough.

There is another element essential to the proper performance of the act of expectoration — the capacity to make such a full inspiration as shall carry the air in beyond the accumulating matter, so that it may on its forcible passage

out again, carry this matter before it. Hence we see why weakness, which prevents a sufficient inspiratory effort, or obstruction of the terminal and most expansible parts of the air-tubes, which renders this effort ineffectual, may stop the act of expectoration, and by permitting the accumulation of matter in the air-tubes may speedily conduce to a fatal result. Inability to expectorate is the immediate cause of death in many cases of various diseases; in fact, it is a part of the article of death itself; and when we hear the rattle in the throat of the dying, we hear the sign of the accumulating barrier which is shutting out the breath of life. Sometimes, even at this stage, there are sensibilities enough in the system to feel the force of a stimulant which may excite the sinking powers to another struggle; expectoration is once more accomplished, and breath once more renewed; and where there is no irrecoverable alteration of structure, this act of expectoration may in some few instances turn the balance in favour of recovery. It is unnecessary to say, then, how important it is to study the act of expectoration, and to acquaint ourselves with those means that may excite or promote it. Most practitioners have seen instances in which a patient has been snatched from the jaws of death by the timely administration of a diffusible stimulus, such as a warm aromatic draught, with carbonate of ammonia or ether, together with such a change of posture and other circumstances as might most favour the expulsion of the matter that was suffocating him. A great deal may often be done in less urgent cases by attention to the posture of the patient. In most instances the act of expectoration is easiest in that posture in which the respiration is most free, which is commonly the semi-erect posture: but some patients expectorate more freely when lying on one side; and we remember a phthisical patient who really appeared to be several times saved from suffocation by alternating his posture from lying down to sitting up in a particular manner, suggested by a knowledge of the condition of the lungs in that case. When this expedient was neglected, the patient was so shaken with frightful fits of fruitless cough, and so oppressed with the accumulating matter, which they could not expel, that speedy suffocation seemed inevitable. In some cases, the act of expectoration may be favoured by another kind of action, in which the expiratory muscles are concerned, that of vomiting; and we shall find hereafter, that some emetics may exert an influence of an important nature on the bronchial tubes, besides this mechanical one.

The character of the expectoration frequently furnishes us with very instructive signs. It is the product of diseased action, and in its physical or chemical qualities it may inform us somewhat of the nature of that action, of the condition, and sometimes of the position, of the parts from which it comes. As, however, we have seen that the effort of expectoration is sometimes unsuccessful, there may be no expectoration to judge of; and besides this instance, most children and some adults cannot spit out what they expectorate, but swallow it.

The basis of expectoration generally is the secretion of the mucous membrane of the air-tubes. This is naturally a transparent, colourless, slightly glutinous liquid, like thin mucilage. The chief animal matter which it contains is that called mucus, which seems to be a sort of imperfectly coagulated albumen, and the varieties of sputa presented by disease commonly depend on an unnatural condition or quantity of this animal matter. There is also saline matter, which may vary in quantity, and so may the proportion of water. From the recent experiments of Dr. Golding Bird, as well as those of Dr. Babington and Mr. Brett, it would seem that the condition of the animal matter in the expectoration depends in great measure on the proportion of saline matter with which it is combined, this being in abundance in transparent and viscid expectoration, and defective in the opaque kind, with little viscidity, and least of all in that which is absolutely purulent. Dr. Babington found, that on mixing pus with a solution of common salt, after a time it became converted into a nearly transparent viscid mass like mucus; and Dr. G. Bird rendered the physical and chemical resemblance perfect by adding a little soda, and then passing

a current of carbonic acid gas through it. (*Guy's Hospital Reports*, No. vi.) Mr. Brett, in a valuable communication to the medical section of the British Association in 1837, states that he found the saline matter of transparent viscid mucous expectoration to amount to from 20 to 33 per cent. of its solid matter, whilst that of the opaque viscid mucus of chronic bronchitis was from 16 to 23, and the puriform expectoration of the last stage of phthisis was only from 9 to 10 per cent. These researches confirm the opinion we have long held, that the difference between mucus and albumen seems to consist in their physical condition, rather than in their chemical constitution. Mucus is a transparent glutinous matter, not coagulable by heat, as liquid albumen is, and not solid and opaque like coagulated albumen; but on ultimate analysis it is not found to differ from this principle. When, therefore, we see expectorated matter opaque and solid, or liquid and coagulable by heat, it loses the only distinguishing characters of mucus, and is strictly albuminous. For this reason, we submit the following general classification of expectorated matter: —

1. *Mucous*, more or less transparent and viscid. 2. *Albuminous*, opaque without viscidity. 3. *Watery*, thin and transparent. 4. *Compound*, composed of combinations of the preceding kinds.

1. *Mucous* expectoration is that most like the natural secretion, being transparent, and more or less viscid. It is the general result of simple acute inflammation of the mucous lining of the air-tubes, in which case it is increased in quantity, and particularly in viscidity; in fact, the glutinous character of the sputa, and the tenacity with which they stick together and to the containing vessel, or fall out in a ropy mass, was described by Andral, and we think correctly, to be a mark and, in some degree, a measure of acute bronchitis. From the researches just alluded to, it would appear that the viscidity of these sputa depends on their quantity of mucus, which is albumen combined with saline matter, to which is sometimes added free uncoagulated albumen. In the most intense forms of inflammation, and where the disease occupies the finer tubes, to the glutinous character of the mucus is added a frothiness, arising from the mixture of those air-bubbles in the tubes, which in their breaking cause the mucous and submucous rhonchi. But the most intense bronchitis is that accompanying inflammation of the parenchyma: here we have the most viscid form of sputum, through which air driven produces the crepitant rhonchus; and the blood in the distended vessels of the engorged parenchyma communicating a little colouring matter to it, gives it that reddish or rusty tinge which is so characteristic of the sputa of peripneumony. The transparent or semi-transparent condition of these viscid sputa distinguishes them from the albuminous kind, into which, however, they pass in the advanced stages of all the more inflammatory affections of the bronchial membrane. The mucous expectoration has commonly a saltish taste, and with its saline matter is probably connected its irritating quality, so marked in the early stage of bronchitis.

2. The varieties of *albuminous* expectoration are pretty numerous, for under this head are comprehended the opaque kinds of sputa which have no remarkable viscidity, such as the purulent expectoration of chronic bronchitis, the fibrinous or polypous sputa of plastic bronchitis, and the more compound combinations of these with caseous and other matters, which are voided in the advanced stages of pulmonary phthisis. This class of sputa denotes an error of secretion, farther than the mucous from the natural standard, there being a defective proportion of saline matter, as well as an excess of albuminous; but their production generally announces a decline of inflammation from its most acute form. Probably, the very throwing off of so considerable a mass of animal matter, is the means of relieving to a certain extent the inflamed vessels; for we frequently find the purulent or polypous expectoration in intense bronchitis attended by a remarkable diminution in the signs of local and general excitement. This remark has been made also by Dr. Stokes. But such an expectoration ceases to be a favourable sign when it *continues*, either with undiminished irritation, or with proofs of general weakness; for then a change is

implied, either in the structure, or in the habitual action of the membrane, which, secreting pus instead of mucus, goes beyond the mere removal of a temporary congestion, and proves of itself a cause of irritation and exhaustion.

Much has been written about the modes of distinguishing pus from mucus in the expectoration. On these formerly the diagnosis of pulmonary phthisis was supposed to depend. These tests are not now much attended to, not only because it is well-known that pus may be produced without any ulceration or consumption of the lung, but also because these distinctions cannot be complete between matters that pass by insensible gradations into each other. The chemical composition of pus resembles that of the colouring globules of the blood, and differs from mucus in containing a notable quantity of iron.

3. *Watery* expectoration is that kind in which a liquid of only slightly glutinous quality is coughed up in greater or less abundance. This appears to contain very little animal matter, and to be rather a diluted mucus than to have in it any thing peculiar. It is often covered with a froth, particularly when it is coughed up with much effort. This secretion is to be regarded as the result of irritation, with a relaxed state of the vessels, rather than of inflammation; but it may occur as a consequence of this lesion, as well as of congestion or obstruction to the circulation of the blood in the lungs. It is the expectoration of what is called humid asthma and pituitous catarrh. Some persons of a relaxed habit have it during a common cold, or any form of bronchial inflammation. It sometimes tastes more salt than usual, and in this case it commonly causes a more incessant teasing cough.

4. Under the head *compound* expectoration, are classed various combinations of the preceding kinds, which we meet with in almost every form of pectoral disease. They are either products of different parts, in distinct pathological conditions, although coughed up at the same time; or they may in some cases proceed from the same part in an intermediate pathological state, and capable of secreting different kinds of matter. An example of the latter is the opaque or muco-purulent expectoration of the latter stages of bronchitis, in which the opacity and colour of albuminous matter is apparent, whilst it is held together by a mucus of some tenacity. In the *concocted* sputa of declining acute bronchitis, the mucus predominates; whilst the loose albuminous matter is more abundant where the inflammation tends to pass into a chronic state. The sputa of chronic bronchitis, and in fact of most chronic diseases of the lungs and air-tubes, are almost always more or less mixed; for it generally happens that the different parts of the membranes and tissues are variously affected; and when, as in the advancing stages of phthisis, there is structural lesion or destruction of parts, there is the greater reason for a more heterogeneous kind of expectoration. In these cases, however, the albuminous kinds mostly predominate, in the form of muco-purulent, purulent, caseous, or tuberculous matter, and coagulable or fibrinous lymph, occasionally tinged or mixed with the colouring matter of the blood: these constitute the bulk of the expectoration of the consumptive. In catarrhal diseases of a chronic kind, we commonly see very opposite forms of sputa expectorated together. Thus in a spitting-dish full of thin frothy watery expectoration, we often find portions of tough and almost solid semi-transparent mucus, as if some parts of the tubes were throwing off the water, and others the animal matter, in a separate form. When the subject of catarrh is treated of, we shall find that these opposite products do not imply an equally opposite pathological condition. After hemoptysis, it is very common to see fibrinous concretions, together with purulent and mucous matter, all more or less tinged with blood. In other affections it is not uncommon to see the sputa streaked with blood; and this sign is of less importance when the cough is violent, because it may then merely proceed from a slight abrasion caused by the force of this mechanical action. When, however, there is often blood present, without much force of cough, and especially if there be pus with it, we may suspect the presence of ulceration in some part of the air-passages. The colouring matter of the blood in an altered state, may also be combined

with other forms of sputa. Thus, in scorbutic persons affected with humid catarrh or bronchitis, the expectoration is a thin reddish brown liquid, like prune juice or diluted treacle; and in the last stages of pulmonary disease, the colouring matter, from the final pulmonary congestion which precedes death, is seen in the dirty reddish brown or greenish tinge of the purilaginous sputa.

It is evident then, that the matter of expectoration will often inform us of the pathological condition of the lungs and their tubes; and its quantity or quality may sometimes suggest proper remedies. In some cases we may learn other things from it. Thus, when in consumption, tubercular matter with portions of pulmonary tissue is expectorated, the conclusion is obvious. We also sometimes see the expectoration present physical signs of the state of the interior by its containing albuminous or compound matter, moulded into the shape of the tubes or cavities from which it comes. The large rounded flocculent muco-purulent sputa of advanced phthisis are often such as could only accumulate in a cavity; and the tubular or vermicular albuminous matter which is coughed up in the plastic kind of bronchitis, sufficiently explains whence it comes, by its being an exact mould or cast of the bronchial tubes, sometimes in an arborescent form, from several of their divisions.

We must not omit to notice a test, which is erroneously used to determine the nature and source of sputa, whether they float or sink in water. The floating of a sputum merely depends on the number of air-bubbles retained in it, and although pus alone, or tuberculous matter alone, will not retain these bubbles, yet a small addition of tenacious mucus will enable them to do so. Again, although the sputa formed in ulcerous cavities are less likely to contain air and to float than those formed in the tubes, yet we not unfrequently find the concocted expectoration of acute bronchitis, which is formed exclusively in the large tubes, sink in water; whilst the mixed product of a vomica and the adjoining tubes, which has been churned together with air, floats. This hydrostatic test of expectoration is then a very inconclusive one; but it may be useful in sometimes causing a rough separation of the albuminous matters from those of a more viscid mucous kind.

Other details regarding the matter of expectoration might be given; but enough has been said to illustrate how it may prove useful in diagnosis and practice. From this it will appear how much more valuable its indications may become when conjoined with the physical signs, by which we may often detect the position, and measure the amount of the local disease, of which the matter expectorated is the product. We shall find many exemplifications of this position hereafter.

Pain. The only other morbid phenomenon, connected specially with the modified vital properties of the organs of respiration, is *pain.* We know that pain may arise either from an excessive impression on the nerves of sensation, or from an excessive sensibility of these nerves, to which common circumstances of position, motion, &c. then become painful. The latter is the more common cause of pain in internal diseases; but it is not unusual to find them combined, as when a tumour, or effused matter, presses on or stretches parts morbidly sensible. The most common causes of pain are inflammation, and those kinds of vascular excitement that are allied to it: this vascular excitement is generally attended, in the first instance at least, with an exaltation of the nervous function. But the nervous function may be *primarily* excited; and although the increased sensibility thus produced seldom lasts long without more or less stirring up the function of the vessels also, yet we may for a time have pains purely nervous, such as pleurodyne and pectoral neuralgia. Further, as inflammation is not the only cause of pain, so the pain present in inflammation is by no means an index of the extent of the inflammation, nor even of its situation. Most extensive inflammations have been known to occur, not only in the parenchyma of the lungs, but in the bronchial membrane and pleura also, without producing any pain; and it frequently happens in phthisis, that the pains chiefly complained of are low down in the sides, when the disease is

almost entirely in the upper lobes of the lungs. So likewise in bronchitis and pneumonia, the pain is often confined to the sternal, lateral, or scapular regions, whilst the disease occupies other parts.

There are, nevertheless, some general characters with regard to pain, which may render it useful as a symptom of disease of the chest. It is commonly remarked, that the pain of parenchymatous and bronchial inflammations is dull and diffused, whilst that of inflammation involving the serous and fibrous membranes of the pleura and pericardium is of a sharp lancinating character. This is generally but not constantly true; and we may find it explained by the circumstance, that the par vagum, which supplies the bronchi and lungs, is by no means so sensitive a nerve as the spinal intercostals, which are distributed on the pleura and pericardium. For this reason, too, there is more apt to be acute pain when the costal pleura or the coverings of the great vessels are inflamed, than when the pulmonary pleura is the chief seat of disease. A further distinction in the variations of these divers kinds of pain will confirm the opinion, that they belong to different orders of sensibility. The dull, heavy, or aching pain of bronchitis, or pneumonia, is generally pretty constant, although it is increased by full inspiration, exertion, or the breathing of cold air; yet even then it gives the feeling of soreness under the sternum, rather than of severe pain. It often resembles the pain of dyspepsia, which is probably seated in a branch of the same nerve, and is also usually referred to the sternum. The degrees of pleuritic pain, on the other hand, are sudden, extreme, and intolerable. If it be not felt in ordinary breathing, a long breath, or a cough, just sufficient to bring the membranes to a requisite degree of tension, causes that sharp stitch of the side — that sudden catch of the breath, that has been considered so characteristic of pleurisy. When it is constant, the patient is obliged to hold his side to diminish its severity, by restraining the motions of the chest; and thus placed in opposition to the sensation which prompts the act of respiration, this sharp pain may cause such a voluntary restraint of these acts, as to bring the patient to the verge of asphyxia. It is under these circumstances that the breathing becomes partial, as formerly described, and patients whom pain constrains to breathe only with the diaphragm or with one side, will perform this supplementary respiration so well, that they are completely free from pain, although the inflammation is as acute and the membranes as tender as ever. Sometimes we may detect the latent tenderness by pressing between the ribs of the affected side; but we are more likely to succeed if we restrain the supplementary respiration by pressing on the abdomen or on the healthy side, and then desire the patient to cough, or to take a sudden long breath. If there be any exalted sensibility or tenderness, it is pretty sure to be discovered by this means; and we have several times met with patients who denied having any uneasiness or tenderness, yet they winced at the pain developed in this way.

As a general rule (not however without some exceptions), we may consider a fixed permanent pain, or a permanent tenderness, which depends on the same pathological cause, an indication of inflammation, or congestion, or some analogous condition of the vessels; and when present it deserves attention, not only as an object of treatment on its own account, but also as an index, which together with the pulse, cough, fever, and other general symptoms, shows the increase and diminution of the complaint, and the effects of remedies, even before these become manifest from the physical signs. Still, if we trust to it alone, it will negatively deceive us in those numerous cases of extensive disease in which it is absent, or scarcely complained of; and it will positively deceive us in those cases in which modified nervous sensibility — a mere neurosis — is the only or the chief disorder.

We come now to examine shortly the nature and value of the symptoms which diseases of the organs of respiration develop in other functions.

Physiology indicates the close relations which subsist between the organs of respiration and those of circulation; and prepares us to expect that disease in

the former should disturb the latter, and develop symptoms in the function of circulation. Accordingly we find such symptoms in the state of the *arterial pulse*, and in that of the *superficial capillary* and *venous* parts of the circulation.

The pulse. The pulse has for ages been relied on as a guide in the diagnosis and treatment of all diseases; but those who have had much experience, know how fallacious it sometimes proves; and those who have had little experience must acknowledge that it is very difficult to distinguish the varieties of the pulse from one another. Some of the fallacies and difficulties connected with the pulse as a sigh, appear to arise from our studying it too empirically,—from our not rationally considering those elements on which its varieties depend, and a knowledge of which would enable us to understand and to foresee the circumstances which are capable of producing these varieties. To guide the student to this knowledge, we will give a brief analysis of the nature and varieties of the pulse of arteries.

The arterial pulse is caused by the jets of blood thrown at certain intervals of time into the arteries by the contractions of the ventricles of the heart. The motion originates exclusively in these contractions, although it may be modified by the blood which is moved, and by the tubes which convey it. Now here are three elements:—1. The heart; 2. The blood; and, 3. The arteries;—and variations in the condition or action of each of these cause varieties in the arterial pulse. Let us consider a few of these variations.

1. Without noticing the modifications in the action of the heart resulting from disease of that organ—a subject to be considered hereafter—it is plain enough, that if the other elements be equal, the strength and frequency or rhythm of the contractions of the left ventricle of the heart, will determine the *strength* and *frequency* of the arterial pulse. But the contractions may have another quality—that of abruptness: being rather brisk and short than strong and complete, they communicate to the pulse that character which is called *sharp*. Now what property in the heart gives it this abruptness of contraction? what but an extreme irritability? There is sometimes this irritability in inflammations and fevers; but we find it also in conditions of mere nervous irritation, of which it is more distinctive. And it is when these coexist with inflammation or fever, that the pulse presents a sharpness, in addition to other qualities more peculiar to inflammation. In sthenic irritation, or those connected with fulness and tone of the vascular system, which may tend either to acute inflammation or to active hæmorrhage or other discharge, the heart's contractions are strong as well as sharp; and so is the pulse. In these cases, although the original irritation were local, it has now reached the centre of the circulation, and thence, distributed through the whole system, becomes general. But let us see how the other elements modify the pulse.

2. There can be no doubt that the blood in the heart and vessels determines by its *quantity* the character of the arterial pulse: very possibly it does so by its *quality* likewise; but this is not so easy to prove. The fulness and strength of the pulse in the arteries depend materially on the quantity of blood in them; and when the pulse is frequent as well as full, there is the greater proof of plethora, inasmuch as it shows that there is a considerable jet thrown into the arteries at each contraction, notwithstanding that the contractions are so frequently repeated. But there may be a full system of bloodvessels without a large or strong pulse,—as when the heart is acting feebly or faintly; and where its irritability is lowered, such a mode of action may be actually caused by the congestion or distension which for a time oppresses the function until it is roused into reaction. Under these circumstances, bloodletting will often increase the fulness and strength of the pulse. The opposite condition—a defective quantity of blood—will modify the pulse differently according to the state of the other elements, the action of the heart, and the arterial tubes. When the irritability of the heart is reduced, together with the quantity of blood, the pulse will become softer, weaker, and less frequent. But it frequently happens, especially in nervous temperaments, or where the depletion

has been carried to excess, that the diminution of the blood is accompanied with an augmented irritability of the heart, and the pulse becomes not only quicker, but sharper than usual; and the effect of the abrupt jets into a small bulk of blood contained in imperfectly distended tubes, is to give to the pulse that jerking or bounding character, as if a mere ball of liquid were suddenly shot through the empty tube, which is so remarkable in the irritation of inanition and chlorosis.

3. But we cannot fully understand the variations of the pulse without attending to the properties of the tubes in which it is felt. If the arteries were tubes of an unyielding or an unvariable character, then the pulse in them would more uniformly represent that of the heart, which would be transmitted through them unmodified. But we know that they are not so: they possess properties of elasticity and tonicity, which vary according to circumstances, and which modify the pulses from the heart, by changing the size of the tubes, and the yielding or the resisting nature of their walls. It is plain that the impulse of a jet of blood must be differently transmitted by vessels when they are large and yielding, and when they are contracted and tense: in the first case the pulse would be *soft* and *full*, in the latter *hard* and *small*. We know but imperfectly what are the circumstances which affect the tonicity and elasticity of the arterial coats, and thereby the pulse: further experiments are wanted to elucidate them, but the following are pretty well-ascertained, and they should not be forgotten in estimating the signs of the pulse. Cold causes the arteries to contract, and therefore renders the pulse smaller. We know how a cold lotion will often diminish the fulness and throbbing of the arteries of an inflamed part; and we have seen the same effect of cold more strikingly produced in the large arteries. In the experiments on the sounds of the heart carried on in February 1835, we repeatedly observed, that when the aorta of an ass, recently killed, was plunged into cold water, it contracted, so as not to permit the introduction even of the little finger, and its coats acquired an increased thickness and rigidity: the pulmonary artery did not contract nearly so much. The circumstance of temperature must therefore be taken into account in judging of the pulse; for cold may render the pulse of an artery small and hard, or, if severe, small and weak, when the action of the heart and the condition of the system would give it the reverse qualities. Heat, on the other hand, within certain limits, tends to diminish the tonic contraction of the arteries; so that under its influence they receive more strongly and fully the pulse from the heart. We know how warmth restored to a limb makes it throb with these expanded pulses.

But there is another circumstance that may modify these actions of heat and cold on the pulse, besides proving by itself a cause of modification — the condition of the capillary circulation. When this is not free, the artery will be more distended, and therefore the pulse harder and stronger than usual; and thus in fevers, where the surface is pale and constricted in the cold stage, and dry and unrelaxed in the hot stage, the pulse often preserves through these changes of temperature a hardness and strength which would be much more varied were the capillary vessels free and exhaling their usual excretion, and which is actually diminished under the influence of a warm bath or temporary moisture of the skin, although the fever still continue. Again, whatever view we take of the nature of inflammation, we cannot, in the present state of pathological knowledge, doubt that the circulation through the inflamed vessels is to a certain degree obstructed; whilst, either as a consequence of this, or from some cooperating influence, the vessels leading to the part become dilated, and being thus more open than others to the pulse-wave from the heart, which their distended coats cannot temper as usual, they become the seat of that throbbing hard pulse, that has been mistaken for increased action of the vessels themselves. And there are many other variations in the pulse explicable on these principles, but this is not the place to consider them further in detail.

There is, however, one more cause of variety connected with the arteries, so frequently occurring, that it must not be overlooked, viz. the difference in the arteries of different individuals. Without any adequate difference in the action of the heart, in the quantity of blood, or in the temperature, we find a very remarkable variety in the character of the pulse in different healthy individuals; and the same difference extends to the modifications of disease. Some have always a soft large pulse; in others it is small and feeble; in others small and hard: others, again, have habitually a hard strong pulse, which scarcely becomes soft under any circumstances. The first depends on the arteries being large, with thin elastic coats. The small feeble pulse may result from their small size and thin coats: this is common in females, and may coexist with inordinate action of the heart. The hard wiry pulse is connected with small arteries with rigid coats; and the same rigidity or deficiency of elasticity in the coats of arteries of larger size gives that unvarying hardness and strength to the pulse which we so often meet with in old people, and which renders it so uncertain a sign in these cases. We may often, in the radial artery, feel the permanent thickening and hardness of its coats, which thus, like a tube of glass or metal, rigidly transmit the heart's pulses, without tempering them by any yielding or spring. With these peculiarities of pulse there are often connected characters of constitution or temperament, and proclivities to disease or health, which are of great importance in guiding us in practice.

Besides the general causes which modify the pulse, which we have now briefly considered, there are some specially connected with diseases of the pectoral organs. Those arising from diseases of the apparatus of the circulation will be treated of in the article devoted to that subject. But severe affections of the respiratory organs also sometimes signally modify the pulse, and that in a manner which may tend to confuse its indications. We know how closely the heart is linked with the lungs; by the circulation even more closely than by mere position; for the lungs may be said to lie between the two compartments of the heart, and any considerable obstruction in the lungs will derange the usual relations of these compartments. There is then a distension or overstimulation of the right side of the heart; while the left, receiving a diminished quantity of blood from the lungs, and that not thoroughly aërated, is less excited than usual, and may give to the arterial pulse a character of weakness and smallness that by no means represents the condition of the whole vascular system, and which often is remarkably contrasted by the action of the right side of the heart, as felt or heard under the sternum. These varieties are produced by any of those affections of the chest which infringe far on the respiratory function. These are more commonly those of the bronchial and parenchymatous kind, which have accordingly been described to be accompanied by a softer and weaker pulse than those affecting the serous membranes. But a pleurisy may occur also with a small weak pulse, when the effusion or pain is such as to interfere largely with the function of the lungs. Neither is it to be supposed that the pulse in severe pneumonia or bronchitis is always weak, even when these affections infringe considerably on the function of the lungs. Even under asphyxiating influences the left ventricle may sometimes become excited, together with the right, and give a sharpness to the pulse, which, combined with the arterial tension of fever, may be readily mistaken for hardness and strength. But this character is seldom permanent; and we generally find in all diseases, when the function of respiration is much impaired, that the pulse soon loses its body and strength. These considerations suggest the expediency of examining the state of the circulation not only by the arterial pulse, but also by the pulsations of the heart itself, and by the condition of the veins and capillaries.

Under the circumstances just mentioned, when the indications of the arterial pulse are most variable and deceptive, we may often find useful signs in the condition of the *venous* and *capillary* part of the circulation. The distension of the more superficial venous trunks, especially the jugulars, in which a double pulsation often shows also the retropulsive action of an over-distended right

ventricle,—the fulness of the capillaries of the lips, tongue, throat, cheeks, eyelids, nails, and other parts, at first having a florid and flushed appearance, but afterwards, as the respiration becomes more injured, assuming a purple or livid hue, — are signs of great practical importance, and of a constancy more approaching to that of the physical signs. They do not, however, present themselves in the early and more tractable stages of disease; and they are always less distinct in pallid persons with small superficial vessels.

Intimately connected with the state of the circulation is the symptom of *general fever*, or *increased heat*, which attends many diseases of the chest. It depends on increased force and rapidity of the circulation, with diminished perspiration. When the perspiration is restored, the heat always falls. This exhalation of fluid not only lowers the temperature by its physical agency of evaporation, but being in itself a sign of a relaxing of the superficial vessels, it implies an abatement of the vital irritation. In the more transient forms of fever, such as the intermittent and hectic, the profuse perspiration sometimes reduces the animal heat to below the natural standard, just as the circulation is proportionately enfeebled; and the same chilling influence is illustrated by the cold sweats which succeed to temporary and irregular excitement. There are degrees of vascular irritation in which the increased heat of skin is partial, and determined by the structure of particular parts. Thus in the asthenic excitement of hectic fever, the heat is most felt in the palms of the hands and soles of the feet, because the circulation is not strong enough to drive the perspiratory excretion through the thick cuticle of those parts, which become consequently dry and hot. The same thickness of cuticle, on the other hand, when once imbued with perspiration, often keeps these parts soft and moist, when there is no sensible perspiration on other parts. Not unfrequently the unequal state of the circulation is exhibited in febrile and inflammatory disorders by the heat of the abdomen, back, chest, or head, whilst the extremities are cooler than usual; and occasionally the same locally increased action is manifested by partial sweats, which prevent the increase of heat, and tend to reduce the excitement. We have known a patient with pleurisy perspire profusely only from the affected side, for several days; and nothing is more common, in slight abdominal inflammations, than to find the pungent heat of the belly relieved by a perspiration equally confined to that part. But we practise on the same principle, in applying to irritated or inflamed parts poultices, fomentations, and partial baths, which tend to bring the skin and superficial vessels to the same relaxed and expanded state which they have in a perspiring part.

Heat of skin, therefore, is an uncertain symptom; for it depends on a condition of the superficial circulation that is by no means constantly associated with disease of the internal organs. When present, it may as much result from a general cause — an idiopathic fever — as from a local inflammation; and cases are not uncommon in which severe, and even fatal, visceral inflammations are attended, through a great part of their course, by free perspiration; nay, the same may be said of some fevers which are called idiopathic. Still the heat and condition of the skin become valuable guides, when taken in conjunction with other signs, inasmuch as they indicate the constitutional disturbance, which is an important part of the disease, and which is sometimes as much to be considered in the treatment as the local disease which has excited it. So, likewise, when the presence of a disease has been established by other signs, the condition of the skin may prove a measure of its increase or diminution more delicate and sooner appreciable than can be found in the physical signs. Thus an increased heat of skin, coming on during a bronchial or pulmonary inflammation, either indicates an increase of that inflammation or the addition of some abdominal or other irritation, which tends to aggravate the condition of the patient. So, too, perspiration breaking out in the hitherto dry and hot skin of a pleuritic patient, occasionally does prove *critical*, whether that word be applied to the excretion as a cause or as a sign of the amendment.

Where there is disorder of the circulation, especially of a febrile kind, we may well expect alteration of the *secretions*, which are so intimately connected with it: hence we find the urine is scanty and high-coloured, and the secretions of the liver and intestines variously deranged. As a natural consequence, too, there will be disorder of the digestive and nutritive function: the tongue will be furred, or florid: the appetite will fail; the stomach will cease to digest; thirst will torment; the blood, no longer fed with chyle, will not duly nourish the textures, nor support the functions: the strength will fail; absorption continuing active, if time permit, emaciation will ensue; and various complications of these disturbances may differently modify the character of diseases of the chest. The sensorial functions, too, may be deranged, either in consequence of the secondary visceral disturbances, or more rarely by a more direct influence of the imperfect respiration on the brain and nervous system. A knowledge of the causes of asphyxia suggests also how certain states of the nervous system may tend to develop disease of the lungs. Thus insensibility, or coma, causes imperfect respiration, and consequently congestion of the lungs; and, as we shall hereafter see, a long-continued congestion of the lungs only requires the addition of vascular reaction to convert it into inflammation. Persons rarely recover from an asphyxiated state, without suffering more or less from the injury which it leaves in the vessels of the lungs: and not a few who have been recovered from suspended animation, have sunk under the pneumonia, or bronchitis, which supervened.

We have thus rapidly glanced at some of the pathological relations of the organs of respiration to other functions, to give the reader an opportunity of considering rationally the nature and value of general symptoms. Dyspnœa, cough, pain, and signs of the circulation, with its concomitant, temperature, although often equivocal, yet when strongly marked sometimes assist us in diagnosis. It is just the reverse with the symptoms arising out of disorder of the other functions. The altered secretions of the kidneys, the liver, and the intestines, cannot inform us of the nature or presence of a disease of the chest; and still less will gastric derangement or sensorial disturbance. Not only will they not direct, but they tend essentially to blind us to the presence of pectoral disease; for they set up prominent symptoms of a new character, that may take the attention entirely from the real source of disease, and fix it on the brain, the liver, the stomach or intestines, the affections of which are only secondary, and often trivial. How often do we find peripneumony, or bronchitis, disguised by delirium or stupor, or by vomiting, a loaded tongue or diarrhœa. How often pleurisy, masked by jaundiced skin, a tender right hypochondrium, and clay-coloured fæces; or by lumbago, or nephralgia. How often tubercular consumption, obscured by sundry bilious, dyspeptic, or nervous symptoms. It will be happy for the practitioner (for his credit at least, if not always for the success of his practice) if he detect the enemy through its false colours, ere it triumph, and before the scalpel shall proclaim the delusion of his unwary mind. The physical signs will enable him to do this, and again we recommend them to the best attention of the student. On taking a rational review of the general symptoms in comparison with the physical signs, we must come to the conclusion that as diagnostic means, the general symptoms fall far short of the physical signs.

But it is not to be supposed that, because the general symptoms are often comparatively of little aid in diagnosis, we are to neglect the study of them. They are almost always of great importance in prognosis and practice. The physical signs more surely show how the pectoral organs suffer; but having discovered this, to the general symptoms we must look for how the system suffers; and as the symptom often closely sympathises with the injured organ, we may through them often watch the first turns of the disease before the change in the organ becomes physically appreciable. In the general symptoms we seek for those *critical* phenomena, which, although sometimes deceptive, yet generally announce the

tendency of the disease to one or other mode of termination. In them we study the vital forces and properties with which nature works, and the signs of what nature can do; and in our methods of treatment these become the standards to which we direct, and by which we modify, our remedies. When we treat a patient with peripneumony or catarrh, we do not apply our remedies merely to the local lesions, inflamed vessels, or a discharging membrane; we study the system at large, we examine other functions through the general symptoms, and we direct our treatment with due reference to indications from all these several sources. We see, then, that the mere stethoscopist is but ill-fitted to practise medicine. He may justly boast of his skill in diagnosis; his place of triumph will be the dissecting-room, where he can show the lesions that he had detected; but his practice at the bed-side will be unsuccessful in proportion as local lesions vary in their general relations, and in the conditions of the constitution, or of other functions that may accompany them. The judicious physician will not omit to study the condition of the vital properties, which are exhibited in the general symptoms, as well as the local physical changes which have been already produced; and whilst he chiefly confides in the physical signs to indicate and measure the present local lesions, he carefully watches in the general symptoms the tendencies of those properties and functions which are capable of increasing or modifying these lesions, and are equally liable to be affected by them. The general symptoms being less intelligible and certain than the physical signs, need more experience to enable us to appreciate them; but we have found that even these also may be *rationally* studied, and may derive a light from a knowledge of physiology and the physical signs, which experience alone could never throw on them.

LARYNGITIS.

General observations.—Two forms of laryngitis—the Acute and the Chronic.—Symptoms of the acute.—Anatomical characters.—Diagnosis.—Causes.—Prognosis.—Treatment.—Chronic Laryngitis—its symptoms.—Anatomical characters.—Diagnosis.—Causes.—Prognosis.—Treatment.

Mucous or catarrhal inflammation not unfrequently affects the larynx, and is the cause of the hoarseness which often attends both mild and severe bronchitis. There are, however, other inflammatory affections of the larynx of a very serious and fatal tendency—those, namely, in which the inflammation affects the submucous cellular membrane, and causes œdematous effusion into this tissue. The swelling which results, narrows the caliber of the larynx, particularly at the glottis, impedes the respiration, and often destroys life. To this form of inflammation the term *Laryngitis* is generally restricted. It may occur under the different forms common to other inflammations, varying according to its exciting causes, and to the state of the constitution. Dr. Cheyne has specified no fewer than nine varieties of laryngeal inflammation, including the catarrhal form. For practical purposes, however and for the sake of conciseness, we shall comprehend all the varieties under the *Acute* (which may be sthenic or asthenic) and the *Chronic.*

I. Acute Laryngitis.

Symptoms. The sthenic form of *acute* laryngitis often begins with symptoms of tonsillitis, with difficulty of swallowing and fever, which is generally preceded by rigors. In this case the extension of the inflammation to the larynx, or its establishment in other cases, is announced by hoarseness, a frequent husky, and sometimes convulsive cough followed by tenderness, pain and con-

striction in the larynx itself, with difficult, prolonged, and sonorous inspiration, the chest being free from signs of disease. On examination the fauces generally, but not always are red and swollen, and sometimes, by pressing the tongue forwards and downwards, the epiglottis may be seen erect, thickened, and of a bright or deep red colour. In this state the epiglottis no longer protects the glottis from the contact of matters passing into the pharynx; hence the act of swallowing not only is painful, but often causes convulsive fits of coughing, and increased difficulty of breathing. At first the fever is decidedly inflammatory: the face is flushed, the skin hot, and the pulse full and hard; but this state is soon changed under the depressing influence of the obstructed state of the respiration. A frightful train of symptoms then ensues, induced by the rapidly increasing impediment to the supply of air. The countenance becomes anxious in the extreme, and pallid; the lips livid; the eyes staring and watery; the nostrils raised; the voice is reduced to a whisper; the integuments in the fore part of the neck are sometimes œdematous; the pulse becomes quicker, feebler, and less uniform. To quote the expressive description of that experienced observer, Dr. Cheyne, "the patient is restless and apprehensive, often changing his position, in the vain hope of obtaining relief; walking, or rather staggering to and fro in great distress: feeling that he is on the point of suffocation, he cannot be ignorant of the danger to which he is exposed; hence he is willing to submit to any means of relief, and is impatient of delay. In this stage the sufferer seldom sleeps for many minutes at a time; when he begins to dose, he starts up in a state of the utmost agitation, gasping for breath, every muscle being brought into action, which can assist respiration, now a convulsive struggle. He is quite enfeebled, becomes delirious, drowsy, and at last comatose, the circulation being more and more languid, and he dies on the fourth or fifth day of the disease, or even earlier." Death has been known to take place seven hours after the attack; in some cases it has been delayed for two or three weeks.

The asthenic form of laryngitis differs from the sthenic in the absence of symptoms of inflammatory fever, and sometimes of pain in the larynx and difficulty of deglutition. In other respects the symptoms are similar; with the same hoarseness and cough at the commencement, difficult and stridulous respiration, rapidly amounting to a feeling of strangulation, as if the upper part of the windpipe were closed, often with fits of convulsive coughing and increased difficulty of breathing, apparently of a spasmodic kind; and after inducing symptoms of partial asphyxia in one of these paroxysms, the disease may prove fatal suddenly or more gradually, by the patient after repeated attacks falling into a state of insensibility.

In one of the asthenic forms of laryngitis, the inflammatory symptoms are by no means prominent; and the affection has long been termed *œdema of the glottis*, because an effusion of serum or pus into the cellular tissue of the lips of the glottis is the destructive lesion, and few other traces of disease are found after death. In other cases, particularly those arising from erysipelas, whether propagated from other parts or at first attacking the throat and larynx, and those of laryngitis supervening on continued fever, small-pox, scarlatina and measles, the symptoms of local inflammation are more severe, pain and difficulty of swallowing are present, and after death, the epiglottis and other parts of the larynx are found inflamed and swollen by the effusion of lymph or pus into their cellular texture. The course of all these forms of laryngitis may be as rapid as that of the sthenic kind, but it is seldom so uniformly progressive, particularly in the œdematous variety, in which the attacks of difficult breathing are sudden and rather severe at first, and may prove rapidly fatal; or they may subside for a while after the expectoration of a little glairy mucus, and recur again with increased severity; in the interval the breathing being pretty free, but the voice still hoarse, and the sensation of a tightness or lump in the throat remaining. In the cases in which the obstruction is chiefly œdematous, it generally occupies the cellular tissue of the glottis, and from thence

to the ventricles, the epiglottis being comparatively free, and there being little or no difficulty of deglutition; but in the erysipelatous cases, as in the sthenic form, the epiglottis is frequently thickened, the patient experiences difficulty and pain in swallowing, the attempt to swallow liquids sometimes causing a spasm so violent as to resemble that of hydrophobia.

Causes. Acute laryngitis may follow exposure to cold and wet. It may originate in cynanche tonsillaris, and, according to Dr. Stokes, in cynanche parotidœa, which he has found to be inflammation of the cellular membrane only, and not of the parotid gland itself. Acute inflammation of the larynx has been brought on by swallowing scalding or corrosive liquids by the convulsive action which these excite in the throat; they are in part thrown on, and even into the glottis. Children accustomed to drink from the mouth of a tea-kettle or tea-pot have often attempted to do this when these vessels contained scalding water; the result has been violent inflammation of both pharynx and larynx. Instances of this accident were first recorded by Dr. M. Hall. Mr. Porter observes, that when a person attempts to drink by mistake a corrosive liquid, a similar convulsive action takes place, closing the pharynx and throwing the offending matter violently backwards through the mouth and nostrils, under the epiglottis, and thus this accident becomes a cause of acute inflammation of the larynx. Mr. Ryland has with good reason placed the inhalation of flame or of very hot air among the causes of acute inflammatory injuries of the larynx. Persons who die from severe burns, if it be only about the head and face, generally suffer from severe dyspnœa, and the mouth and larynx are found in a highly inflamed and congested state: these effects he very rationally ascribes to the great heat of the air inhaled at the moment of the conflagration. The inhalation of very acrid vapours might possibly have the same effect. As exciting causes of asthenic laryngitis, erysipelas, scarlatina, small-pox, and measles, have been already mentioned; and we may add, that inflammation of the tongue from the excessive use of mercury, and diffusive cellular inflammation from punctured wounds, have been known to extend to the cellular tissue of the larynx and cause death. M. Bayle and Dr. Tweedie have noticed that œdematous laryngitis sometimes suddenly supervenes without any obvious cause during and after typhoid fevers. It occurs also not unfrequently in the course of chronic disease of the larynx, and is sometimes the cause of death in these cases. We have known it to come on and hazard life in a patient with aneurism of the arch of the aorta, before the tumour had well-shown itself outwardly: Mr. Lawrence has adverted to similar cases.

Habitual intemperance, long courses of mercury, frequent and long-continued exertions of the voice, are supposed to predispose persons to attacks of laryngitis. Except in case of scarlatina, measles, and small-pox, and of the accidents before alluded to, laryngitis never attacks children; and of those advanced in life, Dr. Cheyne states that it most frequently occurs in such as are liable to indigestion connected with a disordered state of the liver. In most instances, the subjects of it had previously been liable to sore throat.

Anatomical characters. The effects of laryngitis are commonly found in the red injection and thickening of the lining membrane of the larynx, and an œdematous state of the cellular tissue underneath, particularly at the upper portions, from the epiglottis to the ventricles, the parts beneath being nearly or quite free from disease. In the more sthenic cases especially, the epiglottis is very red, thickened, and erect, instead of lying over the glottis. The folds forming this chink are generally also red, and much swollen. On cutting into them, serum, or if the disease have not terminated very rapidly, a sero-purulent liquid or pus, exudes. In a few instances, lymph has been found in the cellular textures, and in two or three there have been small patches of lymph on the glottis and under surface of the epiglottis. Rarely these parts have been found ulcerated, even in acute cases. In the erysipelatous disease, and that arising from diffusive cellular inflammation, the matter ef-

fused in the submucous tissue of the epiglottis, vocal ligaments, and ventricles, is a sloughy kind of lymph with serum, sometimes mixed with pus; and the longer the case has lasted, the more purulent the liquid is. This effusion is often found to extend to the cellular texture at the root of the tongue outside the larynx, and even among the muscles of the neck and throat. In the œdematous variety the epiglottis is nearly free from disease; the mucous membrane is little injected, but the folds of the glottis are so distended, as nearly to close the orifice, and on cutting into them a clear or purulent serum flows out. It can scarcely be doubted, that in most cases this serous effusion is the result of a low form of inflammation; but it may be favoured by the existence of a dropsical diathesis, or by the pressure of a tumour on the neighbouring venous trunks: to the latter cause we would chiefly ascribe the laryngeal symptoms which occasionally show themselves in cases of aneurisms of the great vessels or other tumours at the lower part of the neck. Dr. Stokes notices the occurrence of œdema of the glottis in a patient labouring under a cancerous tumour below the jaw.

Diagnosis. The symptoms of acute laryngitis are generally sufficiently characteristic to separate it from other diseases affecting the breathing. The stridulous or hissing inspiration, heard most distinctly at the larynx, which is drawn down at each act, the seat of the sensation of pain or constriction at that part, often the visible condition of the epiglottis, and the absence of pectoral signs, suffice to distinguish it from diseases of the chest. Abscesses external to the larynx and compressing it, may cause difficulty of breathing and swallowing: sixteen years ago we saw a fatal case of this kind, which was mistaken for laryngitis, until the first incision of the throat after death gave issue to a quantity of pus which had formed among the numerous muscles of the tongue and larynx. A careful examination will generally distinguish these cases by the partial or general swelling at the upper part of the neck, often with tenderness, and an inability to open the jaw. Mr. Porter thinks that they differ from those of laryngitis in the breathing, although obstructed, being less sibilous, and more gradually oppressed, and in the diminished mobility of the larynx when pressed from side to side against the spine. We should conceive that the absence of the peculiar cough and hissing hoarseness of laryngitis might in some cases better assist the diagnosis. Spasmodic affections of the larynx may generally be distinguishd by the complete absence of fever and by the suddenness of the attack; but they may not be so easily distinguished from the œdematous laryngitis supervening on chronic diseases, which is in effect generally combined with spasm: still in this case there is usually a previous slight access of fever and increase of the chronic symptoms. Spasm of the glottis is a very rare affection in adults, and occurs only in hysterical or highly nervous subjects.

Prognosis. Laryngitis has been considered by Dr. Cheyne and others to be the most fatal of all the inflammations. Of seventeen cases observed by Bayle during six years only one recovered. Of twenty-eight cases collected from various authors by Mr. Ryland, ten recovered, which he justly considers to be above the average. In most of the fatal cases, death took place between the first and the fifth days. The prognosis must therefore in all cases be unfavourable; and the more so, as the disease has lasted longer and with progressive increase of the difficulty of breathing. When the face loses its colour or becomes livid, and the faculties obtuse, from the circulation of black blood, the danger is extreme. On the other hand, decrease of the difficulty of breathing and of swallowing, a returning freedom of expectoration, with an improved expression and colour of the countenance, give rational hopes of recovery.

Treatment. In no disease is an early and energetic use of remedial measures more essential to their success, than in *acute sthenic* laryngitis. There is a period during which free bloodletting and the administration of calomel and antimony may arrest the inflammation before considerable effusion has

taken place; but this period is very short, and has often elapsed before medical aid is resorted to; and when once the effusion has taken place, antiphlogistic measures become worse than useless, and unless artificial means of supplying air to the lungs be employed, the disease generally destroys life before there is time for ordinary curative measures, however energetic, to produce their effect. The chief indications of treatment, therefore, are, — 1. to prevent effusion by reducing inflammatory action: — 2. Effusion having taken place, to prevent the obstruction which it causes to respiration from producing mortal injury to the functions: — 3. to promote the removal of the effused matter.

1. In endeavouring to fulfil the *first* indication by free bloodletting, we cannot do better than by quoting the directions of Dr. Cheyne. He recommends free bloodletting but not to syncope, as advised by Dr. Baillie, for this may deprive the patient of strength sufficient to struggle against the next spasmodic paroxysm of dyspnœa. "We would bleed the patient freely during the first twenty-four hours: — we should be disposed to do more: as long as the complexion of the patient is good, we would have recourse to venesection, keeping a finger on the artery while the blood flows, and closing the orifice when the pulse is reduced; we would have leeches applied or blood removed from the nucha by cupping; and we should be disposed to bleed again or even a third time, so as to abstract forty or fifty ounces of blood, and at the same time let the patient have a powder containing two or three grains of calomel, three or four of Pulv. Jacobi Verus, and one half or one third of a grain of opium should be taken every third or fourth hour till the gums become affected." We would not hesitate to give double this quantity of calomel. Dr. Cheyne justly objects to blistering on account of its trifling advantages in comparison with the additional suffering which it occasions, and possible interference with the operation of bronchotomy. Perhaps the same objections would not apply to the speedy and energetic counter-irritation by the strong liquor ammoniæ, which, if applied at the side of the neck in the manner directed by Dr. J. Johnson, may produce vesication in two or three minutes. Dr. Cheyne also deprecates the use of tartar-emetic, lest it should excite vomiting, which with the erect state of the epiglottis would throw matters on the unprotected glottis, and cause a frightfully convulsive irritation. For a similar reason we would object to the direct application of leeches to the tonsils, a measure proposed by Dr. Cheyne. We can testify of its utility in tonsillitis, for which it was first recommended by Mr. Crampton; but the irritation from the bites, and the blood proceeding from them, could scarcely be tolerated with an exposed glottis.

Active depletory measures employed early may for a time relieve the symptoms without removing the inflammation: they often only delay the effusion, which with its resulting permanent increase of difficulty of breathing and appearance of lividity, instead of taking place in the first day, may not come on for several days. Hence the importance of attempting, from the first appearance of the disease, to fulfil the *third* indication by the free use of mercury both by calomel internally and by external inunction; for if the gums can be made sore, a secretion from the throat is established which generally reduces the swelling of the glottis. We have more confidence in the power of mercury to *cure* laryngitis, than in that of bloodletting; and would consider the great utility of the latter to be in so far retarding the progress of the inflammation as to enable the mercury to act before a fatal obstruction is produced. Some few cases have yielded to bleeding alone, and its employment should never be neglected when the strength can bear it, and the conditions so well stated by Dr. Cheyne indicate it. But if the strength have already failed, or these conditions cease, and the undiminished dyspnœa and commencing lividity announce the approach of asphyxia, bloodletting becomes worse than useless, and the *second* indication by the operation of bronchotomy must then be attempted without delay. Dr. Baillie considered it advisable to resort to bronchotomy if no considerable relief be obtained from other measures in thirty hours. Dr. Cheyne

more rationally takes as a criterion the condition of the patient rather than the period; and says that if the symptoms be such as to contraindicate bleeding and yet asphyxia is imminent, *thirty minutes'* delay may be too much: but if the complexion is good and asphyxia not threatened, the operation may be delayed *thirty days.* Surgical writers strongly urge the early performance of the operation. Louis observes, "as long as bronchotomy is considered an extreme measure (*a dernier ressort*) it will be always performed too late;" and Mr. Lawrence says that it should be done, "as soon as the symptoms enable us to determine the nature of the disease." It is because we are convinced that it should be resorted to early, that we have included it in the second indication. If free bleeding produce no relief, or be not borne, and serious difficulty of breathing have become established, we would not wait for the appearance of pallor or lividity as recommended by Dr. Cheyne, and still less for the lapse of a certain number of hours as proposed by Dr. Baillie, but we would urge the performance of bronchotomy without delay. To defer the operation on account of the difficulty or danger attending it, is most unreasonable; for experience has proved that these are increased rather than diminished by delay, and the danger from the operation is at no period to be compared with the danger from the obstruction to the breathing that it is calculated to remove. Laryngitis destroys life, not by the extent or the vitality of the organ which it occupies, but by closing as it were the door of the breathing apparatus: by opening another door we render the disease comparatively trivial; and it may then be deliberately attacked by mercurial and other remedies, or, if slighter, even be allowed to run its course, which commonly ends in mucopurulent secretion. When the operation has been delayed until asphyxia approaches, it will have less chance of success; but should still be tried, for a very few instances are on record where it succeeded at almost the last extremity. It is not within our province to give directions for the mode of performing the operation; but we may state that we have seen reasons for making a free incision between the thyroid and cricoid cartilages, and keeping them separated for the first half hour by the thin handle of a scalpel, and afterwards by a short tube half an inch in diameter, with a projecting rim to *button* into the opening, and a ligature passing round the neck to prevent its slipping in too far. Such a tube may be made in a few minutes of a piece of hollow reed or elder stick, by winding a few turns of waxed twine around the end to be inserted, and passing the ends of the twine through the two holes bored across the outer extremities of the tube, whence they are passed and tied round the neck. The less of the tube that is introduced within the windpipe the better; for the presence of a foreign body often excites terrible paroxysms of coughing. The act of expectoration is often impossible with the opening free; it should therefore sometimes be closed after a long inspiration, that the patient may forcibly expel the accumulating matter by a full expiration through the glottis, which is sufficiently free to the exit of air: varying the posture will aid this act.

Until and after the mercurial action is established, it is often useful to apply leeches or a blister, or other counter-irritants, to the upper part of the chest; for there is a tendency to bronchitis as the laryngeal inflammation subsides; and this extension of disease has, in not a few instances, caused death where bronchotomy had saved the patient from the laryngeal affection. The treatment of the after stage of laryngitis is much the same as for the same period of bronchitis.

The great difference to be remarked in the treatment of *acute asthenic* laryngitis, whether of the œdematous or erysipelatous kind, is in the total absence of a phlogistic period in which general bloodletting may do good. Leeches freely applied to the sides of the larynx, and speedy blistering the sides and back of the neck by the strong liquor ammoniæ or acetum lyttæ, may sometimes diminish or retard the effusion until the system can be brought under the influence of mercury, which here, as well as in the sthenic form, is the only remedy

to be relied on for dispersing the swelling. But if, as it more commonly happens, the progress of the disease towards causing a fatal obstruction be more rapid than the influence of the remedies, the obvious resource will be in the early performance of bronchotomy. These cases will bear even less delay than those of the sthenic disease; for besides that they are still less under the control of remedies, they occur in weakly subjects, which are sooner injured by an obstructed state of the respiration: and it has repeatedly happened that a late operation has relieved the breathing, but the patient has sunk from the injurious influence of imperfectly arterialised blood, which had already circulated in the lungs, brain, and other organs. Hence too even if this influence be not immediately fatal, it may lead to secondary congestions of these organs, which in the form of asthenic bronchitis, pneumonia, or arachnitis, may ultimately endanger, and even destroy life.

In case of the secondary laryngitis, supervening in erysipelas, scarlatina, measles, typhus, and other febrile diseases, due regard must be paid to the original disease, which, according to circumstances, may require a stimulant or an opposite plan of treatment.

II. Chronic Laryngitis.

This form is of more frequent occurrence than the acute, and presents itself in a great variety of degrees. As acute laryngitis is a comparatively trivial disease as long as it is confined to the mucous membrane, and produces no swelling of the tissues beneath, so chronic inflammation may affect the internal surface of the larynx for many months, and produce little inconvenience except hoarseness, habitual husky cough, and perhaps some feeling of soreness at the top of the windpipe. This affection not unfrequently succeeds to a neglected catarrh, especially in those persons who are continually exposed to cold and wet, and are habitually intemperate; for example, hackney-coachmen and street porters. The purple faces of many such individuals give evidence of a congested condition of the capillaries, that in all probability extends to the lining membrane of the larynx; increasing its sensibility and injuring its nice adjustments in the production of the voice. This form of disease may exist long without inducing further change, and tends rather to induce thickening of the membrane and vocal ligaments, than to end in ulceration.

It is different with the serious disease which more commonly goes by the name of *chronic laryngitis*, or *phthisis laryngea*, which, like the acute disease, reaches to the submucous cellular tissue, from whence it may extend to the other constituents of the larynx, and involve them in the intractable and destructive effects which inflammation induces in these less vital textures. The chief of these are, erosion and ulceration of the mucous and submucous tissues; softening, thickening, œdema, induration, contraction, and dissecting abscesses of these textures, and of the ligaments and muscles attached to them; ossification, caries, and necrosis of the cartilages; warty and fibrinous excrescences; scirrhous and tuberculous formations in the different structures. These several lesions may be variously combined, and produce disease of very different degrees of severity, those being the worst forms in which the cartilages are diseased, or extensive ulceration of the other tissues already produced. These more destructive changes may follow simple inflammation; but they are more commonly either the result of a scrofulous diathesis, and often complicated with tuberculous disease of the lungs and other parts; or they are the product of a syphilitic taint, or much more rarely of scirrhous or other malignant disease.

Symptoms. Chronic laryngitis is generally a very insidious disease, often beginning as a common catarrhal cough with hoarseness, and not attracting particular attention until it has lasted for a long time, and seriously injured the general health as well as the tissues in which it is seated. The chief symptoms are hoarseness, a husky dry cough, with soreness or pain in the larynx, felt sometimes on pressure, or rubbing it against the spine, sometimes only in the act of swallowing. Of these, the most constant sign is the change of the voice, which

varies very much in degree and kind. The dry, stridulous, or squeaking kind of hoarseness, if permanent, generally implies a worse form of disease than the deep, loose, or mucous hoarseness which may proceed more from relaxation: sudden loss of voice may occur with slight diseases affecting the thyro-arytenoid ligaments, or a nervous affection of the muscles, and may not be permanent; but where a voice gradually becomes more and more cracked until it is at last lost, there is probably a progressive destruction of the vocal apparatus. In some cases the defect of the voice is perceptible only on speaking loud, or in any attempt to vary the tone; for the patients instinctively acquire the habit of speaking in that tone and degree in which the voice is best produced. Pain is so uncertain a symptom, that Trousseau and Belloc state that in more than half the cases of laryngeal phthisis which fell under their observation, there was no pain throughout the disease. There is, however, generally increased sensibility of the larynx, so that the inhalation of cold air, or any hurry of the circulation, very readily excites coughing. The cough, which in the early stages is commonly short, dry, and hacking, is described by MM. Trousseau and Belloc to assume in some instances in the later stages a very peculiar loose continuous character, like eructation or belching, which they ascribe to an inability to close the glottis, its closure being the first act of an ordinary cough. As the disease advances, there is often abundant purulent and sanious fetid expectoration, sometimes streaked with blood; but not unfrequently the sputa are scanty and chiefly mucous. The occurrence of purulent expectoration is sometimes accompanied by a relief to the breathing, although the voice may suffer more, and there may be more pain or soreness in coughing; this marks the formation of an ulcer, the discharge from which diminishes the constriction of the air-passage. Instances have occurred of the expectoration of dead and ossified portions of the arytenoid and cricoid cartilages, and of calcareous concretions formed within the larynx; and in more than one case, such solid fragments have fallen back into the trachea, and caused much irritation and consequent disease in one of the large bronchi. The respiration generally becomes affected sooner or later in chronic laryngitis; the difficulty of breathing commonly coming on in the night, and on any exertion sometimes in very severe spasmodic paroxysms, leaving the patient only with a short breath in the interval. The attacks of dyspnœa afterwards increase, and prevent the patient from lying down; and in the interval, the hissing sound of the laryngeal breathing indicates some degree of permanent impediment to the passage of the air. After the orthopnœa has once commenced, death generally ensues in a fortnight or three weeks; but at an earlier period the patient may be suddenly carried off by an attack of acute œdematous inflammation of the glottis. Of nine fatal cases of œdema of the glottis, examined by MM. Trousseau and Belloc, five occurred in the course of chronic laryngitis. In many instances, chronic inflammation and ulceration of the larynx are accompanied by progressive emaciation, hectic fever, night-sweats, and other signs of phthisis, without marked dyspnœa; and the patient is ultimately worn down by cough and weakness, and is perhaps carried off by diarrhœa or some other superadded disorder. In by far the greater number of these cases, tubercles are formed within the lungs, either before or after the laryngitis begins, and becomes the chief cause of the decline, although too gradual in their effect to affect the breathing in a marked degree. In a few instances recorded by Trousseau, Belloc, Ryland, and others, the laryngeal lesion was uncomplicated with any pulmonary disease, the consumption having been purely laryngeal. In most of these cases the cartilages of the larynx were diseased. Chronic inflammation and ulceration of the larynx and trachea are very common with tuberculous consumption of the lungs, and are the cause of the loss of voice, and smarting or pricking sensation in the larynx, so often occurring in the advanced stages of phthisis. Ulceration was found by Louis in upwards of a fourth of the cases of phthisis noted in his work.

Causes. Chronic laryngitis may succeed to the acute disease; but it much more commonly arises from the frequent recurrence of catarrhal inflammation,

particularly in those who are addicted to ardent spirits. Excessive exertions of the voice, repressed eruptions, wounds or contusions of the throat, foreign bodies introduced into the larynx (among which may be mentioned the habitual inhalation of air loaded with dust), and the extension of syphilitic disease from the throat, may be enumerated as occasional exciting causes. A scrofulous or tuberculous constitution particularly predisposes to laryngeal phthisis. The excessive use of mercury, habitual intemperance, and other debilitating influences, are also supposed to render persons more liable to chronic inflammation of the larynx. The disease appears to be most common at the middle period of life. According to Mr. Ryland, it affects women more frequently than men, but this is at variance with the experience of MM. Trousseau and Belloc.

Anatomical characters. We have already enumerated the principal lesions which chronic laryngitis induces. They are very various, and have been minutely described by Porter, Lawrence, Stokes, Ryland, and Trousseau and Belloc, to whose work (particularly the last) we refer for details. The simplest effect of the chronic inflammation is, 1. Redness of the mucous membrane in patches; even when not ulcerated, it has often a rough granular appearance, from the irregular enlargement of the mucous follicles. 2. Thickening of the submucous tissue: this is frequently observed in the epiglottis and the lips of the glottis, causing enlargement and diminished mobility of these parts: the ventricles of the larynx are sometimes nearly obliterated from the same cause. 3. Contraction of the ligaments, wasting, induration, and fibrous degeneration of the muscles which move the cartilages of the larynx: this is a common result of chronic inflammation on fibrous and muscular textures, and must in this case impair or destroy the mechanism of the voice. Contraction, together with partial thickening affecting the epiglottis, renders it curved or corrugated, so as to defend the glottis very imperfectly. 4. Ulceration of the mucous and submucous textures: this is a common result of chronic inflammation, and presents itself in great variety as to form and seat, of which the following are the most remarkable: the ulcers are sometimes small and round, but confined to the mucous membrane: in other cases they have been known to penetrate to the cartilages or ligaments; and M. Andral notices a solitary case in which one perforated the thyroid cartilage, just above the insertion of the vocal ligaments. In this case the voice was unaffected. When these ligaments are injured, the voice is generally destroyed. When again the ulcers are large and superficial, denuding but not injuring the vocal cords, there is commonly hoarseness, but not aphonia. It is between the vocal ligaments and the epiglottis that ulcers are most commonly found, but they are often met with in other parts of the larynx and trachea. They are frequently seen on the laryngeal surface of the epiglottis, and sometimes at its margin; it is only in case of syphilitic disease that the upper or lingual surface is found affected. Considerable parts of the epiglottis, as well as of the arytenoid and cricoid membranes and cartilages, have in a few instances been found destroyed by ulceration. 5. The ulceration, however, does not frequently extend to the cartilages except in young subjects. MM. Trousseau and Belloc do not consider the cartilages of the larynx sufficiently vital to take on the process of ulceration or caries. The common effect of ulceration of the adjoining textures on them is in the first place ossification, and afterwards necrosis. The cricoid and thyroid cartilages naturally become ossified in advanced life; but chronic laryngitis of two years' duration produces the same change in young persons. This is in conformity with a law well-developed by Andral, that a certain degree of irritation accelerates in tissues those changes to which time would naturally bring them. The osseous matter is deposited in irregular places on the surface of the cartilage, and sometimes quite encases it. Instances of necrosis of the cricoid, arytenoid, and even of the thyroid cartilages, have been recorded by Porter, Lawrence, Cruveilhier, Ryland, and Trousseau and Belloc. The last authors state that they have found this lesion in more than half of the fatal cases of laryngeal phthisis which they have examined. In this state the cartilages are denuded of their perichondrium, and

are of a dirty dull hue without their natural lustre. The sequestrum of dead cartilage is not readily thrown off; but there is often fetid pus in the cellular texture near it. These abscesses may open and discharge their offensive contents, and even the dead portions of the cartilage, either into the larynx, or outwardly through the integuments of the neck, or into the œsophagus. It can readily be conceived how much local and constitutional irritation these dead matters may produce before they are discharged, and how in the very act of separation, acting as foreign bodies, they may produce suffocation.

Diagnosis. The most characteristic signs of chronic laryngitis are the permanent change of the voice and the peculiar cough before described, with hissing breathing and pain or tenderness in the larynx when these happen to be present. Except in syphilitic cases where the fauces are also diseased, little is to be learnt from examination of the throat; for it is impossible to see or reach further than the epiglottis, and to get a view of this is a matter of difficulty. Neither is crepitation felt on pressing the larynx to be depended on; for, according to Trousseau and Belloc, this may be produced in a healthy larynx. Dr. Stokes describes, as a stethoscopic sign of chronic laryngitis, a harshness in the sound of the air passing through the larynx, giving the idea of a roughness of surface, perceptible even when the breathing is not distinctly stridulous. In a few cases he observed above the thyroid cartilage a rhonchus, like the sound of a valve in rapid action, combined with a deep humming. We much question that the latter sound was seated in the larynx, for such a sound is often produced in the jugular veins. When the laryngeal constriction is considerable, the peculiar sound of the passage of air through it will sufficiently distinguish it; and where it is slight or altogether absent, laryngeal disease may yet be known as the cause of the cough and other symptoms, by the negative indications of the thoracic organs, the sound of percussion and of respiration being good throughout the chest. But pulmonary tubercle is very commonly conjoined with laryngeal disease, and the two affections are apt to disguise each other. The noisy laryngeal respiration, and the absence of the voice may destroy the chief distinctive signs of phthisis in its early stages; but as the disease advances, the dulness on percussion and perhaps cavernous rhonchus in some part of the chest, particularly under a clavicle or scapular ridge, with a more copious purulent expectoration, night-sweats, and more rapid emaciation, sufficiently announce this most destructive complication. When the breath and sputa in laryngeal disease are very fetid, it may be suspected that some part of the cartilages is dead. This is generally the case where a chronic abscess opens outwardly about the thyroid cartilage.

Prognosis. The milder and simple forms of chronic laryngitis are by no means incurable; in fact they generally yield to judicious treatment; and were it not for their liability to exacerbations from acute œdematous inflammation and to complications with pulmonary disease, they could hardly be called dangerous. Both these destructive complications may be apprehended when the disease has continued long, with increasing severity of symptoms of the voice and respiration, with a change of the cough from dry and ringing to loose and undivided, with increasing purulent expectoration, and particularly if the disease has resisted treatment. If from the history of the individual there be any suspicion of a scrofulous tendency, and particularly if symptoms of pulmonary disease, such as slight cough, shortness of breath, pains in the chest or shoulders, quickened pulse, &c. preceded those of the laryngeal affection, the prognosis is unfavourable; and if there are found any physical signs of phthisis, such as dulness under a clavicle, the case of the patient must be considered almost hopeless. Fœtor of the breath and sputa, implying mortification of the cartilages, is also very unfavourable; but it is more probable that the dead portions of these may be thrown off, than that tuberculous disease of the lung combined with a laryngeal lesion may be cured. In all doubtful cases, particularly those of a syphilitic origin, the state of the general health and strength, as well as

the degree of the local affection, must be duly taken into account in estimating the probable issue of the case.

Treatment. The curative indications are, 1. To subdue the chronic inflammation and to promote the removal, as far as possible, of its effects on the structure; 2. To relieve urgent symptoms as they arise; 3. To improve the condition of the general health.

1. It is necessary to premise, that as a condition essential to the success of any mode of treatment, the diseased parts must be kept as much as possible in a state of rest by suspending the exercise of the voice, which is the work of the larynx; and to effect this it is sufficient to limit the patient to speak in a whisper only, which exerts the larynx no more than respiration does. This restriction is a more practicable one than that to absolute silence. The protection of the parts from the irritating influence of cold air, smoke, dust, &c. is also very necessary. This may sometimes be effected by means of a respirator, without confining the patient to warm rooms. As is generally the case in chronic inflammations, general bloodletting is useful only to relieve temporary congestions, or in plethoric subjects to prepare for the better action of other remedies. Local bleeding, especially by leeches, is more frequently beneficial, particularly in case of temporary increase of the local symptoms, when the cough is more troublesome than usual, with pain or increased tenderness in the larynx. They should be applied to the sides of the larynx or under it; and if they give relief they may sometimes with advantage be repeated in small numbers, every two or three days for some length of time. In a greater number of instances, however, more benefit will be derived from continued counter-irritation at the sides of the neck or upper part of the chest; and for this purpose the tartar-emetic solution or ointment, or a caustic issue, or well-managed seton, will answer better than blisters. A succession of pustular eruptions, or a discharge of pus from beneath the cutis, has an influence over an established chronic inflammation of a submucous tissue far greater than serous discharges.

To modify the action of the diseased textures, and to promote the absorption of the solid matter effused in them, no measure has been found so efficacious as a mild mercurial course, carried to the extent of affecting the gums. Unlike in the acute disease, there is time enough to produce this effect without giving very large doses; and as soon as it takes place, there is generally a diminution of the pain and constriction in the larynx, improvement of the voice, and a loosening of the cough. If the disease be not of long standing, and there be no extensive ulceration, or disease of the cartilages, the means already named will often effect a cure. But where the disease has lasted long and induced considerable local lesions and constitutional derangement, other measures, both local and general, should be employed. In cases where the influence of mercury might be hurtful, as in those of a strumous diathesis, a course of hydriodate of potash with an excess of alkali will sometimes prove very beneficial. The inhalation of steam, in some cases rendered slightly stimulant and alterative by the addition of camphor, turpentine, or a balsam, has been found useful in promoting the secretion of the diseased membrane. MM. Trousseau and Belloc place much confidence in medicaments applied directly to the diseased part, and some of those which they recommend are of a very energetic kind, such as nitrate of silver, corrosive sublimate, sulphate of copper, &c. They may be applied either in solution or in powder. The solution which they have found most effectual is that of nitrate of silver in the large proportion of from one to two parts in four parts of distilled water. This solution may be applied to and behind the epiglottis, by a small roll of paper bent at its moistened end. A more effectual mode is with a small round piece of sponge fixed to a long rod of whalebone bent, at an inch from the sponge, to an angle of eighty degrees. The patient's mouth being opened wide, and the tongue pressed down with a spoon, the sponge is passed to the top of the pharynx; as soon as it reaches the fauces, a movement of deglutition takes place, which carries the larynx upwards, at which moment the sponge is brought forward and squeezed under

the epiglottis, and the solution freely enters the larynx. Convulsive cough and sometimes vomiting ensue; but the application causes no pain. A less disagreeable mode of applying the solution is by a small silver syringe, filled one fourth with the solution and three fourths with air. To this is affixed a tube five inches long, bent at the free end, which being carried beyond the epiglottis, the syringe is forcibly discharged, and in consequence of the air in it throws the solution not in one stream but in a fine shower, part of which enters the larynx. The patient is then made to rinse his mouth with and swallow salt water, or water acidulated with muriatic acid, which decomposes the remains of the nitrate; the same precaution should be used where this agent is applied in substance. MM. Trousseau and Belloc found this application (which they term cauterisation) highly beneficial in several cases of chronic laryngitis. In cases of aphonia, probably dependent on relaxation rather than inflammation, it effected a cure in a few days; in some worse forms of the disease, with probably ulceration of three or four years' standing, its repeated application during five or six weeks was successful; and it produced considerable temporary improvement in three cases which proved afterwards to be tuberculous. Solid substances may be applied to the larynx in powder by insufflation, as recommended by Aretæus for angina maligna. The powder is put into one end of a reed or glass tube, and the other is carried back as far as possible into the mouth: after a full expiration the patient closes his lips around the tube, and inspires suddenly and forcibly through it, by which some of the powder is carried into the larynx and trachea. The cough which is excited should be restrained as much as possible, to prevent the too speedy expulsion of the medicine. The powders used by MM. Trousseau and Belloc are subnitrate of bismuth, which may be used pure with safety and advantage in most forms of chronic laryngitis, even that accompanying phthisis; calomel with twelve times its weight of sugar; red precipitate, sulphate of zinc, and sulphate of copper, each of which must be mixed with thirty-six times its weight of sugar; alum with twice its weight, and acetate of lead with seven times its weight of sugar; and nitrate of silver with twenty-two, thirty-six, or seventy-two times its weight of sugar. The last is said to be most effectual in erythematous laryngitis with erosions or ulcerations. Calomel and red precipitate have proved beneficial in ulcerations, whether syphilitic or not, but they should not at first be repeated oftener than twice or thrice a week. The others may be used twice or oftener daily, according to the nature of the case. The powders should be impalpably fine; the least roughness or perceptible fragment of a crystal excites such efforts to cough as insure the expulsion of the powder. This description of the treatment of MM. Trousseau and Belloc is taken from an abstract in the *British and Foreign Medical Review* by the writer, and appears to be well-worthy of the attention of British practitioners, in proving the safe direct application of powerful agents, which as in external diseases are likely to improve the action of the diseased parts.

2. The second indication — to relieve urgent symptoms, especially requires attention, when the attacks of difficult breathing or of cough are very urgent. These arise in some degree from spasm, and may often be relieved by sedatives and antispasmodics, such as belladonna, camphor, ether, and opium, both taken internally and applied by inhalation in the steam of hot water. Drs. Graves and Stokes recommended particularly the use of a belladonna plaster to the external throat, and a hot pediluvium. If, however, the more gradual supervention of the dyspnœa, with feelings of increased uneasiness in the larynx, and perhaps some fever, indicate that the aggravation of the symptoms is produced by an attack of œdematous inflammation, and this be not speedily relieved by leeching, it may be necessary to adopt the surgical means of relief recommended for that affection, avoiding dangerous delay after the character of the attack has been clearly made out.

3. The third indication — to improve the condition of the general health, is in many cases a point of the first importance; and until it be fulfilled, any other

measures may be of no avail. No particular rules can be laid down for this purpose; but the practitioner may well be guided by the state of the constitutional symptoms. To preserve a due balance of the secretions, to improve the nutrient functions by a well-regulated mode of diet and regimen, aided by mild alterative tonics, such as sarsaparilla and saline chalybeate waters, and especially to assist both nature and art by placing the patient in a salubrious and congenial climate, are the objects chiefly to be aimed at, in order to fulfil this indication. When the disease has a venereal origin, a proper course of mercury will generally be indicated; but this will often fail, unless measures be at the same time taken to improve the general health; and if this have already suffered much from mercury in repeated or ill-directed courses, or in a strumous habit, it will be necessary, for the time at least, to use the iodide of potassium and other general measures, with whatever local treatment the nature of the case may admit. In such cases, fumigation of the fauces with cinnabar (sublimed from a hot plate, or a laundry iron) will sometimes improve the character of the local disease.

TRACHEITIS, OR CROUP.

Symptoms of its various forms. — Anatomical characters. — Nature. — Diagnosis. — Causes. — Prognosis. — Treatment.

THIS disease has been described under a variety of names: *Tracheitis; croup; cynanche vel angina trachealis; cynanche stridula infantum; angina polyposa, membranacea vel exudatoria; tracheitis infantum*, &c. Its essential pathological character is inflammation of the trachea, attended by swelling of the tissues, and often by the exudation of a concrete albuminous membrane, which, by the spasmodic contractions which its presence excites in the windpipe, occasions difficult and stridulous breathing. This disease, so serious and destructive in early life, has been the subject of several able treatises; and although its existence was scarcely recognised till the middle of the last century, it is now as well understood as other diseases of the air-passages. In the history of the usual form and progress of the disease, we shall often avail ourselves of the descriptions given by the latest writers, Dr. Cheyne and Dr. Copland.

Symptoms. For practical purposes, rather than because they are in an obvious degree so presented in nature, it is useful to divide the symptoms into, 1. Those of the invasion; 2. Those of the developed stage; and, 3. Those of the collapsed or suffocative stage.

1. The first symptoms of an attack of croup are by no means distinctive; they are commonly of a catarrhal kind, but with more fever, perhaps a more hard hollow cough, with alternate chills and heats and flushing, a loaded tongue, hoarseness, heaviness of the eyes, fretfulness, restlessness at night, and sometimes a manifestation of uneasiness in the throat, by the child frequently putting the hand to it. The presence of bronchial inflammation at this time is shown by the sonorous and sibilant rhonchi heard in many parts of the chest; but the tracheal breathing is not yet stridulous.

2. The developed stage of the disease is manifested by stridulous inspiration, which is like a sonorous or sibilant rhonchus, only much louder; it can be heard through the stethoscope or ear applied to the neck, before it is otherwise distinct: the cough is of a peculiar rough barking or ringing kind, followed by an inspiration more hissing and sonorous than usual: hence the combination of the cough and inspiration has been compared to the barking of a puppy or the crowing of a young cock: the voice becomes decidedly hoarse: the pulse is frequent and hard: the carotids beat strongly, and the pulsations of the heart are heard all over the chest: the skin is hot; the face flushed; the eyes watery and injected; the head thrown back; and the child is extremely restless, and in-

dicates pain or uneasiness about the trachea and larynx, which is often slightly swollen externally, and tender to the touch. These symptoms generally come on at night, and may somewhat subside in the morning; but the quickness of pulse, stridulous breathing, and hoarseness continue. The remission may last until the evening, or until the patient falls asleep, when the symptoms soon return; and become more severe than ever; the difficulty of breathing, with its accompanying distress, being increased. The cough is more harassing and convulsive, and threatens suffocation; the respiratory muscles are thrown into their fullest action; and whilst the whistling inspiration shows the constriction of the upper portion of the air-passages, the indistinctness of the respiratory murmur in the chest, and the concave state of the intercostal spaces at each inspiration, show how little air enters the chest. All these symptoms become more and more urgent, particularly the state of the breathing and the cough, which now sometimes ends in vomiting or in the expectoration of viscid phlegm, occasionally streaked with blood, or containing shreds of opaque albuminous matter, and in rare cases, a tubular mould of the trachea formed of this matter, like a piece of softened macaroni. The voice, too, by this time has become changed to a hoarse whining note, and afterwards is suppressed; the pulse becomes excessively frequent, and sharper and smaller; the face and neck become more swollen, and either purple or pallid, especially during the fits of coughing. During the intervals, the child remains in a half stupid state, the whole strength being given to the act of respiration. The disease may reach the acme of this stage within twenty-four hours, in rapid cases; but in those of slower progress, in which there have been several remissions, perhaps following the expectoration of the viscid or albuminous exudation before noticed, this stage may be protracted through several days; and, in favourable cases, terminate in recovery without passing to the third stage.

3. The third or collapsed stage is marked by a general failure of the vital powers, the difficulty of breathing being undiminished. The pulse becomes extremely weak, thready, and irregular; the cough more suppressed; the voice gone; the face swollen and pallid, or with the lips slightly livid; the neck full, the superficial veins distended, the skin cold and perspiring, and the efforts of the poor little sufferer to get breath are most painful to behold; they become weaker and weaker, and at last cease; or, in the case of infants, they are sometimes cut short by a fatal convulsion. From this stage, recovery can take place only in the rare event of free expectoration of the albuminous exudation. The noisy state of the tracheal breathing renders it difficult to investigate the state of the chest; but there may sometimes be heard, especially after coughing, a general mucous rhonchus throughout the lungs; and in some instances the chest becomes partially dull on percussion.

Such is the common course of croup in its severe forms: but, as in the case of other inflammations, the disease may vary in intensity; and, instead of being precisely of the character described, it may exhibit sthenic, asthenic, and catarrhal varieties in regard to the fever and inflammation; and it may be more or less complicated with a spasmodic tendency.

The sthenic form attacks plethoric and robust subjects, with high fever, strong pulse, hard cough, pain in the larynx, with little or no remission in the stridulous constricted breathing; and, unless very promptly treated, passes into the stage of collapse, and proves fatal in from twelve hours to five or six days.

The asthenic form occurs in debilitated or cachectic subjects, especially those reduced by previous disease: the fever is low, and the progress of the disease more tardy; but the stage of collapse supervenes early, if the disease be severe. The albuminous exudation often extends to the throat and fauces, and is then identified with the *Diphtheritis* of Bretonneau, especially in the asthenic form of croup, which occasionally comes on in connection with scarlatina and cynanche tonsillaris.

The catarrhal variety of croup is by no means uncommon, and forms the link between the plastic and mucous inflammations. It is attended with much

cough, and various rhonchi in the chest, and, from the extent of the inflammation, is often of a very serious character, its favourable issue depending on the free expectoration of tenacious bronchitic mucus. Like both croup and bronchitis in children, it is liable to remissions and exacerbations, dependent partly on the subsidence or increase of the inflammatory swelling, and afterwards of the secretion within the air-tubes, and partly on temporary spasmodic constriction induced in the upper portions. This form of croup may supervene on ordinary bronchitis, adding to its symptoms the stridulous inspiration and ringing cough indicative of the constriction of the trachea and larynx. The addition of croupy symptoms to bronchitis, or of general bronchial inflammation to croup, must be considered a serious aggravation of the simple disease.

The spasmodic form of inflammatory croup is that which, occurring in irritable children of a nervous temperament, and disposed to nervous affections, presents a preponderance of spasm in the constriction causing the difficult breathing: hence the attacks are more sudden, and may be very severe; but they are succeeded by more complete remissions than in the purely inflammatory form. There may be every degree of combination of the nervous with inflammatory symptoms; the most inflammatory kind of croup is not free from some admixture of spasm, particularly in its advanced stages; and the asthenic and catarrhal varieties generally evince, by the sudden character of the exacerbations and remissions of difficult breathing, that the muscles of the larynx and trachea are thrown into a temporary spasm. But there are cases in which there are few inflammatory symptoms; and the more nervous the subject, the more readily may even slight bronchial and tracheal inflammation excite this spasm. So it may happen, too, that mere nervous irritations, such as from teething, disordered bowels, worms, &c. may, without any inflammation, cause spasmodic constriction of the windpipe, and thus imitate croup; this is the true *spasmodic* croup, which will be noticed hereafter.

Anatomical characters. On examining fatal cases of croup, there are generally found a variety of lesions in the respiratory organs, indicating the effects of different degrees of inflammatory action. In the instances in which death has occurred early, the mucous membrane of the trachea, and generally of the larynx and bronchi, is found to exhibit bright vascular redness, continuous or in patches; and it is often covered with a viscid mucus, sometimes tinged with blood. The submucous tissue between the rings of the trachea, and in the looser parts of the larynx, is often much swelled: at a more advanced stage, is mixed with an opaque yellowish or grey white albuminous matter, in films or patches, often tinged with blood, adhering to the mucous membrane; and in the sthenic cases that have run their full course, this is of such abundance and consistence as to form a false membrane or a tubular mould of the trachea, in some instances extending to the larynx or bronchi. This is obviously the product of the inflamed membrane; and it is remarkable that in the most sthenic cases, or purely inflammatory croup, it is usually thickest and most consistent, but confined to the trachea; whereas in asthenic cases it is thin, loose, and often extends to the bronchi. In some of the severest and most speedily fatal cases, the albuminous matter is found in a semifluid state intermediate between lymph and pus; and this matter has been sometimes expectorated when the disease has not proved fatal. The membrane is neither so red nor so much swelled as in the earlier stage, before the albuminous effusion has taken place. In catarrhal croup this effusion is in smaller quantity, and mixed with an abundant viscid mucus. In the more spasmodic forms, a false membrane or opaque exudation is seldom found, but merely viscid mucus covering patches of vascular redness, especially in the larynx. In most instances that have lasted for some days, and in all of the catarrhal variety, the bronchi exhibit the marks of acute bronchitis, and contain much viscid mucus. Sometimes, too, in such cases, portions of the lung have been found in the state of inflammatory engorgement and hepatisation; and signs of inflammation are now and

then seen in the pleura. Interlobular and subpleural emphysema are also occasionally met with.

Nature. The nature of croup has been the subject of much discussion. In Dr. Copland's *Dictionary*, the reader will find an account of the various opinions which have been held respecting it. Our limits do not permit us to enter into these; and we shall only give that view which, in the present state of our knowledge, seems most tenable, and which best comports with the whole history of the disease and the effects of remedies on it. These indubitably prove true croup to be essentially an inflammatory disease of the air-passages, especially of the trachea and larynx. But why does it differ from the catarrhal or bronchitic inflammations which we find to occur in the same parts? Many authors seem to consider its seat to be the same as that of catarrhal inflammation, and that the difference of its product (lymph instead of mucus) is to be ascribed to the early age at which it most frequently occurs. But this is insufficient; for, at the same age, we meet with bronchitis affecting every portion of the air-tubes, yet without constituting croup. Others again, and among them Dr. Copland, refer the peculiarity of the product to an excess of albumen in the blood; but even this, although it probably has a share in determining the amount of membranous or other solid formations within the air-tubes, does not alone seem sufficient to cause it; nor can it be ascribed to the intensity of the inflammation; for although the albuminous effusion is generally thickest and most tough in sthenic cases of croup, yet it is pretty abundant in asthenic cases; so much so, that Andral and Gendrin consider plastic inflammations of mucous membranes to be rather of the subacute than of the most acute kind. To say that the inflammation is one of a specific character, throws no light on its nature. But does not the pathological and anatomical history of croup seem to point out that the seat of its inflammation is deeper than that of bronchitis? The distinct and circumscribed position of the inflammation and painful constriction in the most marked cases; its fixedness in this part, not wandering or creeping about, as catarrhal inflammation does; the tenderness, and sometimes the swelling of the trachea and larynx externally; the nature of the product of the inflammation, which is coagulable lymph, as from serous or cellular membrane; the thickened state of the submucous texture found after death in the earliest stages, and the tendency of this texture to suppurate in chronic cases, where the subject approaches adult age, — seem to render it probable, that the inflammation owes its peculiar character and results to its being more deeply seated, more of a phlegmonous character than mucous inflammations, and involving essentially the submucous cellular tissue. This view has not been generally held; Mr. Ryland alone distinctly inclines to it, when he remarks, that "the inflammation of croup appears in the first instance chiefly to affect the cellular tissue that enters into the composition of the mucous membrane, and not the muciparous follicles themselves; and the albuminous exudation is poured out by the secernent arteries of the cellular structure." Dr. Stokes remarks, that no satisfactory explanation of the greater frequency of croup in the infant has been given; and he seeks to account for it by the general fact of the predominance in the young subject of white tissues, which reproduce their kind. This idea may lead to an explanation, but it does not set it forth; and it leaves still a mystery why croup differs from bronchitis in the same subject. But if we examine the air-tubes of young subjects, we find in them, as in other parts, an abundance of the fine submucous cellular tissue, whilst the mucous membrane is more fine and less complex than it becomes in after life, when, from the continued irritations to which it has been exposed, its follicular apparatus attains its full activity and development. The blood, too, in the young subject, abounds with the plastic material of nutrition, which is more abundantly thrown out under the influence of inflammation, than in the adult. Yet, as long as the inflammation, even in young subjects, is confined to the mucous membrane, the disease is simply catarrhal or bronchitic, and its product mucous or purulent.

But the inflammation may readily reach the active and vascular submucous tissue, and then it has the more fixed character of the inflammation of croup, the product of which easily transudes through the fine mucous membrane; and, as in the analogous case of serous inflammations, which are also seated chiefly in the subserous tissue, the product is coagulable lymph. In adults, where the mucous membrane is more developed, and the submucous tissue less so, inflammation is less likely to reach the latter: when it does, it attacks the looser parts of the larynx, and, modified by the active mucous secretion, its product is pus instead of lymph; or it may be confined to the tissue, and cause the œdema, thickening, or purulent infiltration of laryngitis.

The pathological history of croup is quite intelligible. The inflammation may commence at first in the submucous tissue, or it may have been first catarrhal, in which very common case, catarrhal symptoms precede those of croup. The inflammation immediately causes increased sensibility of the contractile fibres, and interstitial effusion in the lining of the trachea and larynx: hence results the constriction, partly spasmodic, partly from swelling of the air-tubes; and hence the croupy inspiration and cough, and the hoarseness. Afterwards lymph is poured out in a liquid state, and becoming concrete, forms the false membrane, another cause of obstruction to the passage of the air, both directly by its bulk, and also by the spasmodic contraction which its presence causes in the muscular fibres of the tube. The latter cause acts especially when the false membrane reaches to the larynx, and excites its very irritable muscles: in such cases, the paroxysms of dyspnœa and cough are frightfully severe and suffocating. The share which spasm has in causing the dyspnœa may be inferred from the fact, that in no case have the air-passages been found so much blocked by the albuminous secretion as to account for the amount of the obstruction; and in many cases the constriction has appeared greatest, where little or no exudation was found after death. It must not be forgotten, however, that œdematous swelling, like that of erysipelas, may disappear after death. The separation of the concrete matter from the tube, and the prevention of its becoming permanently adherent and organised, is doubtless owing to the mucous secretion and the continued motions of the tube. In cases where the albuminous effusion is less plastic, or the follicular mucous secretion more abundant, the matter may be liquid and purulent; and this generally takes place in the bronchitic variety. The collapse which takes place towards the fatal termination of croup is, like that in bronchitis, to be ascribed to the imperfect state of the function of respiration, and the consequent injurious effect on the vital powers. The lividity, coldness, occasional attacks of convulsions, &c. are the result of the circulation or stagnation of imperfectly oxygenated blood. From the same cause arises, also, the congestions in the lung, which may in parts take on the irritation of inflammation and become hepatised. The emphysema occasionally detected in the lungs, is plainly produced by the violent efforts of breathing.

Diagnosis. The very peculiar sound of the breathing and cough, and altered voice, are generally sufficient to distinguish croup from other diseases; and it is important to know that the stridulous inspiration may often be detected through the stethoscope applied to the trachea, before it is otherwise distinct. A ringing cough, like that of croup, is often present during the early stage of measles, before the eruption has come out, but it soon becomes catarrhal, and is unattended by the croupy inspiration. In the advanced stages of croup, when the respiration is become so feeble as to lose much of its peculiar character, it may be more difficult to determine whether the obstruction be in the windpipe or in the chest; but then the comparatively good sound on percussion of the chest, and the concave state of the intercostal spaces at each forcible inspiration, showing that there is room in the chest for the air if it could find its way in, will generally suffice to distinguish croup from diseases of the chest. Such diseases being, however, a common concomitant of croup, the existence of the signs of bronchitis or pneumonia does not disprove the

existence of croup. The loud sound of the tracheal breathing of croup may in great measure obscure any signs of disease within the chest; but, as Dr. Stokes has remarked, this is seldom the case constantly, particularly at the early stage of the affection, or after the act of vomiting, when, the tracheal sound being less, the sonorous and mucous rhonchi of bronchitis, and the crepitation of pneumonia, would be heard if they were present. From spasm of the glottis, or purely spasmodic croup, and hysterical affections simulating it, inflammatory croup may be distinguished by the presence of febrile symptoms, the less sudden and more permanent character of its attack, and other points in its history.

Causes. Exposure to cold and damp is supposed to be one of the most common exciting causes of croup. It prevails most generally in cold climates, especially in damp situations exposed to the east. In England, it is a far more common disease near the eastern than the western coast. Nothing is more apt to bring on croup in children predisposed to it, than exposure to a keen east or north-east wind. This wind is remarkable for its dryness; and we are inclined to think that the influence which damp situations seem to have in favouring its occurrence, is that of a predisposing rather than of an exciting cause. There can be little doubt that residence in low, humid, and ill-ventilated places gives to children an increased susceptibility to the influence of cold and other morbific causes; so that this and other inflammatory diseases may be more readily excited in them. Hence it prevails in the clay-bottomed valleys of chalky districts; in the more exposed parts of fenny countries; in some of the deep valleys of Switzerland, through which, low and damp as they are, the cutting winds from the snow mountains sweep in great severity. As it may, from these causes, be endemic in particular situations; so, from the prevalence of cold east winds, particularly after relaxing damp weather, it may be epidemic at particular seasons.

The ages at which croup most commonly occurs, are from one to six years; it is rarely met with before and after these ages. There are very few cases on record, of true inflammatory croup in the adult. Diphtheritic affections, on the other hand, frequently occur in mature age. We have before mentioned that croup may supervene as a sequel or concomitant of other diseases, such as bronchitis, measles, scarlatina, small-pox, &c. It also comes on from too early exposure during convalescence from febrile disorders. In some families there is a strong predisposition to croup; which fact is not more extraordinary than analogous tendencies to catarrh, quinsy, &c.; and its inflammatory or spasmodic character depends on the prevalence of the phlogistic or nervous diathesis, which may attach to families as well as to individuals.

Prognosis. Croup is a most serious disease: if not arrested by treatment, it generally leads to a fatal termination, and it often baffles the most active measures. According to the statements of M. Double, the mortality in the present day is nearly one half of the whole numbers attacked: formerly, when the treatment of the disease was less understood, it amounted to nearly four fifths. Whenever, therefore, the disease has declared itself by the croupy inspiration and difficult breathing, the patient is to be considered in great danger; and this danger is increased in proportion to the time during which the breathing continues to be oppressed. The supervention of convulsive paroxysms of cough, also, brings the patient into immediate jeopardy, either of sudden suffocation or convulsions, or of speedy and often fatal collapse. The proportionally small size of the larynx in children, compared with adults, no doubt adds, as Dr. Copland remarks, to the danger of the disease; but we cannot admit that it is a predisposing cause, as Dr. Cheyne has supposed. In the confirmed stage of croup, the chief hope is in the removal of the albuminous exudation by coughing and vomiting, or by the free expectoration of muco-purulent secretion. The vital forces are not often sufficient to accomplish this; but cases have occurred, in which by these means children have been snatched from the jaws of death, and recovered speedily or

slowly according to the bodily strength and the freedom of the organs of respiration from remaining disease. The coexistence of bronchial or pulmonic inflammation much increases the danger of severe croup; but it does not render the case quite hopeless; and the slighter attacks of croupy inflammation supervening on bronchial inflammation, are less dangerous than the severe forms of the simple disease.

Treatment. The curative indications in croup are well-stated by Dr. Copland. 1. To diminish inflammatory and febrile action when present, and to prevent, in these cases, the formation of a false membrane, or the accumulation of albuminous matters in the air-passages: 2. When the time for attempting this has passed, or when it cannot be attained, to procure the discharge of these matters: 3. To subdue spasmodic symptoms as soon as they appear: and, 4. To support the powers of life in the latter stages, so as to prevent the recurrence of the spasms, and to enable the system to throw off the matters exuded in the trachea. (*Dict. of Pract. Med.*)

If the disease is in its earliest stage, described as that of invasion, the first indication should be pursued with promptitude and energy. An emetic of tartarised antimony or ipecacuanha is the first and best remedy in all cases; and in the slighter ones it may cut short the disease, especially if followed by a warm bath and a dose of calomel and James's powder, repeated every two or three hours, and carried off, if necessary, by a dose of castor oil. In general, however, the relief is not complete, and the pulse becomes harder and the countenance more flushed after the operation of the emetic. If there be considerable fever, and the other symptoms of the invasion be pronounced, it is proper at once to resort to bloodletting with as much freedom as the strength of the patient will bear. Dr. Cheyne recommends venesection to be practised (in the jugular vein of very young children) ten minutes after the exhibition of the emetic: by this mode, the loss of a few ounces of blood induces vomiting followed by faintness, which lasts for some time, a powerful impression being made at a small expense of blood. For severe cases he advises a repetition of the bleeding in two or three hours; and leeches, if necessary, afterwards,—avoiding their application to the larynx, because, in case of excessive bleeding, pressure cannot well be applied there. Dr. Copland thinks that, for town practice, bloodletting by cupping between the shoulders or to the nape of the neck, or leeches to the top of the sternum, is preferable to venesection; and he states that the loss of little more than an ounce or an ounce and a half of blood for each year of the patient's age can well be borne, whilst the nausea from the emetic continues. M. Guersent recommends the bleeding before the emetic, for which he prefers ipecacuanha. As it appears to be a great object to reduce the inflammatory action without an excessive loss of blood, and as bloodletting alone is rarely sufficient to cure croup, the plan recommended by Dr. Cheyne is to be preferred; but we think with Dr. Copland, Goelis, and other writers, that local bleeding will generally be sufficient in young children, and all that are not plethoric.

In the second stage, when the symptoms are fully developed, and the stridulous dyspnœa permanent, bloodletting is less effectual, and not so well borne: it can, therefore, only be used at the earlier period of this stage, and then with caution: the albuminous effusion having then taken place, which bloodletting will not remove, our endeavours must be also directed to fulfil the second and third indications; and these are, in the first instance, still best pursued by remedies called antiphlogistic. Of these, the most powerful are antimonial and mercurial medicines. Dr. Cheyne first recommended tartar emetic in 1801; and stated, in 1832, that he had found no other remedy worthy of confidence in the second stage of croup. The dose is from a quarter of a grain to half a grain repeated every half hour or hour, until it induce sickness; and then hourly whilst the inflammatory symptoms continue, as long as the strength of the patient will admit. Dr. Stokes and Mr. Porter follow Dr. Cheyne in recommending this remedy as the chief one in croup: the former places it above bloodletting.

The late Professor Hamilton of Edinburgh, J. P. Frank, Michaelis, and others, depend chiefly on calomel in large doses, as first recommended by Dr. Rush of Philadelphia. The long and extensive experience of the former physician at Edinburgh, where the disease prevails much, entitles his advice to our attention. He recommends large doses to be given and repeated at intervals of one or two hours, until they cause dark green stools: a very large quantity is sometimes required to produce this effect, relief generally ensuing on their appearance, but not before. The remedy thus given, sometimes causes great exhaustion, which is to be counteracted by wine or other stimulants. After venesection and an emetic in the first instance, Dr. Hamilton places implicit confidence in calomel, which he considers to have a specific operation, and not that of a purgative or derivative merely. We have found this remedy a most valuable one, especially in the less sthenic and more spasmodic form of the disease; but we do not consider its operation to be different from that in other diseases of children, such as pneumonia and hydrocephalus, in which, as soon as it affects the system, it causes copious spinach-like evacuations. It probably acts both by derivation and by diminishing the albuminous contents of the blood, as well as by the peculiar alterative or sorbefacient operation which it exerts in inflammatory diseases, when it affects the system, and which is visible in the case of iritis. In all severe inflammatory cases we confide in tartar emetic and calomel used conjointly, rather than on either separately. The tartar emetic may be given in the manner recommended by Dr. Cheyne, taking care to watch in very young children against the symptoms of sudden depression that sometimes come on during its use. The calomel is best given in large doses, once, twice, or thrice in the day, so that it may act freely on the bowels. From two to four grains for children below the age of two years, and from four to twelve grains above that age, according to the strength of the subject, and the violence of the inflammation, are more effectual than smaller doses more frequently repeated. If the bowels are irritable, a minute quantity of opium in Dover's powder, or in the Pulvis Opiatus, should be added; and if there has been diarrhœa, the Hydrargyrum cum Cretâ in double quantity may be substituted for the calomel, but is much inferior in antiphlogistic power.

Blisters have been generally recommended immediately after bloodletting; but their application requires caution, particularly in very young subjects, in whom they are apt to cause sloughing. In such cases, silver paper or gauze moistened with oil should be placed between the blister and the skin, and the blister should not be left on for more than three or four hours. The nape or side of the neck is the best place for applying them, and not the throat, for this is too near the inflamed part. In consideration of the deep-seated character of the inflammation, we should anticipate a more effectual result from counter-irritation by tartar emetic, which has a deeper and more permanent operation than blisters. The sides of the neck should be rubbed downwards with a brush or coarse flannel until they are red, and then with a sponge or flannel dipped in a saturated solution of tartar emetic for five or ten minutes: this leaves a vivid erythema, which in the course of a few hours forms a great number of small pustules, which discharge a sero-purulent fluid for several days. A more speedy mode of counter-irritation, and one well-suited to the spasmodic variety of croup, might probably be found in that by strong liquid ammonia, in the manner described by Dr. Johnson: he found that, by two minutes' application of lint moistened with this liquid, and covered with a wooden pill-box, or a wine-glass, a number of small vesicles were produced; and by this means a suppurating surface could be quickly obtained.

The second indication, to procure the discharge of the products of inflammation in the trachea, is to be attempted through the operation of emetics and expectorants. The tartar emetic before recommended is the most suitable medicine whilst the pulse retains its force and regularity; and it may be pushed to the extent of inducing vomiting two or three times in the day, if the hourly doses should be insufficient to have this effect; but this must not be done

without caution and due regard to the strength of the patient. When the inflammatory symptoms have in great measure subsided, and the continued croupy breathing is caused by the false membrane with spasm, a less debilitating emetic, such as tincture of squills (ʒ ss ad ʒ j) with sub-borate of soda (gr. x ad gr. xx), in warm decoction of senna or infusion of chamomile, or ipecacuanha wine (ʒ ij ad ℥ ss) with ammoniated tincture of valerian (♏ xv ad ʒ ss) in some convenient vehicle. Looseness and fluidity of the secretion of the air-tubes, and a consequent facility to expectorate it, are materially promoted by alkaline medicines, which seem to possess considerable attenuant power. Hence, probably, the efficacy of warm alkaline baths, which have been recommended by several authors, and which are useful adjuvants to the other remedies both in the early and later stages of croup. In the early stage, the temperature may be about 92°; but when the inflammatory stage has subsided, it should not be less than 96°; and this heat should be kept up during the whole time of immersion, which may be from half an hour to an hour, or even more, if it afford marked relief. It has been advised by some writers to promote expectoration by means of inhalation of the steam of hot water, rendered stimulant and antispasmodic for the after stages by additions of camphor, æther, and ammonia. The application of these remedies is not easy in young subjects, especially when the breathing is already so embarrassed; but they may be sometimes advantageously used, particularly in the more spasmodic cases, by holding under the patient's mouth a jug of very hot water with the medicines added. The use of a sternutatory, in form of strong snuff gently blown into the nostrils, has also been found to aid the removal of the albuminous deposit from the air-passages, and in a measure to relieve the symptoms.

We have already mentioned some of the means calculated to diminish the spasm which so commonly adds to the constriction of the air-passages; and when, from the more remittent character of the croupy breathing, this spasm seems to be a chief cause of the difficult breathing, besides emetics, which are the most effectual antispasmodics, assafœtida, æther, musk, camphor, and opium, may be employed with some benefit; but they must be given with caution, and still in combination with calomel and ipecacuanha. Counter-irritation of the sides of the neck, by means of flannel wetted with oil of turpentine and æther, or even the strong liquor ammoniæ, and covered with oiled silk, or a glass vessel inverted over it, to prevent evaporation, is a powerful means of relaxing spasm, and one that causes less risk than internal stimulants.

In the last stage of croup, when the inflammatory symptoms have given place to those of prostration and collapse, the effects of unsubdued disease and of the unsuccessful lowering treatment, the only resource is in stimulants and cordials, by which the powers of life may perchance be excited until the respiration be restored to a better state. Dr. Cheyne remarks, that this is "a time when we may with advantage lay aside all lowering remedies, and give burnt brandy and ammonia, to which may be added calomel with a minute quantity of opium, and the application of spirit fomentations to the surface. Gasping, failure of the pulse, a pallid or livid and clay-cold surface, show that our only faint hope is in cordials: it must be admitted, however, that a clear discovery of the point at which this change of treatment ought to take place, is the reward of clinical experience alone, and cannot be made in the closet." (*Cyc. Pract. Med.*, art. Croup.)

It is unnecessary to dwell on the modifications in the treatment required in the varieties of the disease which have been noticed; they will be suggested by the character of the symptoms. Thus, cases of the asthenic form of croup will ill-bear bloodletting; and, should the disease be unsubdued, may very soon require the exhibition of stimulants in addition to the other remedies. Both in it, and in the catarrhal varieties, blisters are more beneficial than in the sthenic form. In catarrhal croup, also, purgatives are useful throughout the disease; and they do not, as in the bronchitis of adults, tend in any degree

to check the expectoration. The expediency of using antispasmodics, in the more spasmodic form, has been already adverted to.

It is not necessary to discuss the question of the propriety of resorting to tracheotomy in croup; as it has been decisively negatived by Dr. Cheyne, Mr. Porter, and other of the best authorities. The trachea of young subjects is so small, vascular, and difficult to open, and, above all, the obstructing matter of croup so frequently extends into the bronchi, or cannot be dislodged, even from the trachea, through an incision, that the dangers are many, and the chances of success so few, that in general it can scarcely be said that the performance of the operation is justifiable.

The subjects of croup are very liable to a relapse during their recovery from the disease. The increased vascularity of the submucous tissue, and the augmented irritability of the muscular fibres of the trachea and larynx, may continue, although not to sufficient extent to cause croupy symptoms; but whilst this is the case, slight exposure to cold, the too early use of animal or stimulating food, or the hasty suppression of a free action of the bowels, or of a discharge from a blistered surface established for the cure, may excite the inflammation afresh, and bring back the stridulous breathing. In these relapses, the disease has commonly more of a spasmodic character than in the first instance, the phlogistic condition of the body having been reduced by the previous treatment. It is of great importance to watch patients during their recovery, and to guard against the recurrence of the disease, by continuing to give occasional moderate doses of mercurial purgatives, and an expectorant mixture with an alkali; and to maintain some degree of counter-irritation in the vicinity of the neck, by means of tartar-emetic solution or an ammoniated liniment. Even after apparent recovery, the child should be kept warmly clothed, and not be permitted to venture out of doors, until the season becomes mild, and there is no easterly wind. It may often be requisite to remove to a warmer climate, especially to a southern or western coast. When the season is warm however, and the complaint entirely gone, relaxing heat is to be avoided; the throat and chest should be daily sponged freely with vinegar or salt and water, and afterwards the whole body well rubbed with a coarse-towel.

LARYNGISMUS STRIDULUS.

History and causes.— Nature.— Diagnosis.— Prognosis.— Treatment.

Of spasmodic affections of the larynx, the most remarkable is that which affects infants, and has been called *Laryngismus Stridulus — Asthma Infantum — the Crowing Disease — Spasm of the Glottis — Spasmodic Croup, &c.*

History and causes. In the first instance, the attacks generally come on during sleep: the child starts suddenly, and, instead of crying as usual, struggles for breath, the face becoming flushed, swollen, and even purple: after repeated efforts a long inspiration takes place, often accompanied with a hooping or crowing noise, and the child then recovers its breath and voice, and generally bursts into a fit of crying, sometimes remaining dull and heavy for two or three hours after. These attacks are apt to come on more frequently during sleep, and whilst the child is awake, particularly on being irritated, or too suddenly tossed in nursing, or on being exposed to a cold wind. The infant will then throw his head back, and struggle for breath, recovering it with the noisy inspiration before described. This noise is not however constantly observed, and depends on the partial opening of the rima glottidis; in some cases it is opened completely, and there is no crowing, just as the hooping is occasionally absent in pertussis. In the intervals there may be no disorder

of the breathing or of the general health, but more commonly it attacks children that are delicate and irritable with disordered bowels. It is apt to occur during the period of dentition in children who are badly fed and much confined in too warm or ill-ventilated rooms. In severe cases it may return several times in the day, and as the fits become more frequent, they last longer, sometimes pass into general convulsions, and have in many instances proved fatal.

According to Drs. J. Clarke, Cheyne, and Marsh, this affection is often accompanied with a convulsive contraction of the hands and toes, the hands being clenched on the thumbs, and the great toes drawn in: these circumstances, together with the fact that general convulsions sometimes succeed, have induced these writers to consider the crowing disease as symptomatic of incipient disease of the brain. Dr. Cheyne relates three cases in which examination after death discovered such lesion: in one, scrofulous tumours in the brain; in another, venous congestion and serous effusion; in the third, induration of the brain and obliteration of the convolutions. In two fatal cases Dr. Merriman found no trace of cerebral lesion, but only a collection of enlarged glands in the lower part of the neck, which appeared to have pressed on the par vagum. The late Dr. Ley was led by these and similar cases to ascribe the crowing disease to the influence of enlarged glands or other tumours compressing and partially paralysing the recurrent or inferior laryngeal branch of the par vagum. Frank and Kopp in Germany have found an enlarged state of the thymous gland in some cases of this disease; and the latter has therefore named it *asthma thymicum*. They appear to refer it to direct pressure on the air-tubes, but it is more probable that an enlarged thymous gland would at first act by compressing the recurrent nerves. It had long been known that the section of this nerve or of the par vagum above its source occasioned a permanent contraction of the glottis, sufficient to suffocate quickly. Magendie and others concluded from this experiment that this nerve supplied the muscles which open the glottis, and that those which close it are influenced by the superior laryngeal nerves. Dr. J. Reid has however lately shown that the latter are chiefly sensitive, and not motor nerves, and that nearly all the motions of the larynx are affected by the recurrent nerves. We cannot then explain the closure of the glottis on the division of the recurrents, without referring it to a reflex action on the constrictor muscles through the sensitive nerves. The facts however that division of the recurrent nerves causes closure of the glottis, and that aneurisms and other tumours pressing on them have been known to occasion fits of difficult laryngeal breathing, form so far a fair ground for the view of Dr. Ley, that we may admit that enlarged lymphatic glands may sometimes have a similar effect. It has been objected by Dr. M. Hall, that were paralysis the cause, the affection ought to be permanent and not in fits; but this objection is not valid, for the paralysis is not supposed to be perfect, but that the muscles which it affects are unable to antagonise the constrictors of the glottis only when these are unduly excited by the immediate cause of the paroxysm. The effect of such a pressure as can be exerted by enlarged glands would be a weakening of the motory power of the recurrents, rather than a paralysis; and its influence would be manifest in the power to keep the glottis open, failing only when the act of crying, vomiting, a sudden fright or the like cause, tends to close it with more force than usual. But although disposed to admit the condition described by Dr. Ley as a common cause of the crowing disease, particularly in its milder forms, we think that there is sufficient evidence to show that it is sometimes symptomatic of cerebral disease and the forerunner of convulsions, or some other formidable symptom of cerebral disease. The cases of Dr. Cheyne point to this conclusion; and we may mention one of a child long under our care, which, after being subject to attacks of this affection for nearly two years, became idiotic. The muscular apparatus of the glottis is so nicely adjusted, and the aperture so narrow in children, that any disease of the

nervous system affecting the motory apparatus is very likely to be manifested first here; afterwards as it becomes further advanced, by contraction of the hands and feet; and ultimately by more general convulsions or by paralysis, according to the nature of the lesion. But we do not consider that slight attacks of the croupy inspiration are always to be referred either to pressure on the recurrent nerves or to any permanent lesion of the nervous system. The crowing noise which many quite healthy children make on being too abruptly tossed in the air, or on being exposed to a high wind, obviously proceeds from a momentary contraction of the glottis under the excitement of the sudden motion. This shows how readily this contraction may be excited; and it is rational to suppose that other causes of mere irritation to the nervous system, such as dentition, disordered bowels, and worms, may occasionally produce the same effect, without inducing any further mischief. Like other spasmodic affections, spasm of the glottis may be induced by temporary irritations as well as by permanent changes of different parts of the nervous system.

Diagnosis. The absence of fever, the suddenness of the attacks and of their cessation, and the freedom of the respiration in the intervals, distinguish this affection from croup. The absence of cough prevents it from being mistaken for hooping-cough. The character of the crowing sound, and the absence of signs of any disease of the chest, distinguish it from all other affections of the respiratory organs.

Prognosis. From what has been stated as to the nature of the affection, it may be inferred that it varies greatly in its importance. When it proceeds from teething or disorder of the bowels, it may cease as soon as the source of irritation is removed. The fits themselves may prove fatal by lasting so long as to cause asphyxia; but we apprehend that this will rarely happen unless there be some permanent disease or great weakness of the system. But if the fits recur frequently and are excited by slight causes, there is considerable danger of cerebral congestion or effusion and convulsions being induced by the frequent interruptions to the respiration and circulation. For this reason the frequent recurrence of the fits is dangerous, even if there be no sign of permanent disease in the system. If there be contraction of the fingers or toes, the case is still more formidable, but still not hopeless; for even this symptom may be caused by temporary irritation of the nervous centres. If the affection can be traced to glandular swellings in the neck, or to similar or thymous tumours within the chest, it may generally be removed by prompt and judicious treatment; but if neglected and allowed to become habitual, it may soon destroy the general health, and prove fatal either of itself or by inducing other disease.

Treatment. The paroxysm is of so short a continuance, that there is scarcely time for the application of remedies to remove it. If it threaten suffocation before the crowing inspiration announces its decline, it may be useful to dash cold water in the face, or to blow forcibly into the ear of the little sufferer: these impressions will often succeed in relaxing the spasm, although they are sufficient to excite it when not present. Antispasmodics have very little effect. When the fits come on very frequently, the warm bath may be used, if it can be done without fretting the child, which must be avoided as much as possible, as tending to excite the fits. Dr. Marsh mentions a case of a child two years old, in which very frequent attacks complicated with general convulsions were stopped and suspended for a month after the administration of a tobacco enema (v gr infused in ℥ j of water).

The most important part of the treatment is that directed to remove the causes of irritation, to improve the general health and the tone of the nervous system, and thus to prevent the recurrence of the paroxysms. When the affection is connected with teething, the gum should be divided in any part where it is hot or swollen, whether a tooth be pressing or not. Teeth often irritate long before they are cut; and although the incision of the gum over them do not effect their extrusion, and may by taking blood from their

capsules even retard this process of dentition, it relieves the irritation which they occasion. A judicious course of purgative medicines will be found useful in almost every case, beginning with mercurials followed by castor oil, and keeping up their action by daily doses of rhubarb and magnesia or sulphate of potash, or by some of the stronger purgatives if the bowels are torpid, recurring occasionally to the mercurials whenever the excretions are clay-coloured or too dark. Dr. Merriman recommends that aperients be used so as to produce at least two full evacuations daily. Dr. Joy mentions a case in which, after purgatives and change of air had failed, the affection was removed on the occurrence of a spontaneous diarrhœa. Whenever there is any appearance or suspicion of the existence of glandular swellings as a cause of the disease, it will be proper to exhibit a course of alkaline medicine with small doses of the hydriodate of potash. Dr. Merriman found that the continued use of soda, or a strong infusion of burnt sponge, materially contribute to the cure of the complaint; and this is quite in accordance with the view that he and Dr. Ley have taken of its nature. In case of convulsions or an approach to them shown by contractions of the fingers and toes, strabismus, &c. it may be necessary to draw blood from the temples and nape by leeches or cupping, and to apply cold to the head, while the lower extremities are bathed in warm water. But it often happens that there is an atonic or anæmic state of the system rather than plethora: in such cases bloodletting is eventually hurtful; and much benefit may be derived from the judicious administration of tonics, preceded by and combined with aperients.

All writers agree in considering the management of the regimen and food of the greatest importance in this disease. Change of air is often of more avail than any system of medication; and the child should be carried out in the open air as much as possible, only avoiding cold winds; and its apartments should be well-ventilated without exposure to partial currents. If it do not bring on the attacks, free sponging of the body with cold salt water every morning should be practised; or if the child be very delicate, it may be used tepid. The clothing also requires particular attention; in cold weather, a sufficiency of warm woollen clothes must be worn, and on no account should the arms and chest be left uncovered from October to June; the neglect of this precaution through the vanity of mothers, has occasioned the sacrifice of many children. The food should be nutritious but simple, given at regular hours and not more in quantity than the stomach can digest: if the child is under twelve months of age, it is by far the best plan to nourish it by the breast only to the sixteenth or eighteenth month, due attention being paid to the health of the nurse and changing her if necessary; but when this cannot be accomplished, the best first substitute is asses' milk or cows' milk, a little sweetened and diluted with half its bulk of lime-water or pearl-barley gruel. For children above the age of two years, milky and farinaceous food with a little meat or broth alternately once a day, will generally be most suitable.

NERVOUS AFFECTIONS OF THE LARYNX, IN THE ADULT.

1. *Spasmodic affections of the larynx in the adult* are generally connected with some inflammatory or organic disease there, or by the presence of a foreign body; but occasionally they occur as the result of more distant spinal or nervous irritation, under the garb of hysteria. The sensation called *globus hystericus* is sometimes distinctly attended with a spasmodic constriction of the glottis, which is probably excited by wind in the stomach or even in the œsophagus, for it is generally relieved by flatulent eructation. The choking

sensation produced on swallowing too large a morsel is also in part owing to spasm of the glottis: all these associations of symptoms are rendered more intelligible by the experiments of Dr. Reid, which prove the sensations and motions of both pharynx and larynx to depend on the same nerve — the vagus. More rarely the constriction is of a more enduring kind, and accompanied by fits of croupy breathing and a convulsive ringing cough. Like the crowing inspiration of infants, this may arise from temporary irritation, or from more permanent disease of the nervous centres. Dr. Stokes mentions cases in which spasmodic affections of the larynx terminated in inflammation of, and effusion under, the membranes of the brain. The same writer describes another case in which a patient, long tormented by all kinds of hysterical disease, with occasional obstinate fits of laryngeal spasm and cough, died suffocated by an abscess involving the cricoid, without any other organic lesion. May this abscess have originated in a tumour, which caused by reflected spinal irritation the long train of spasmodic symptoms from which this patient had suffered? Nervous affections of the larynx chiefly affect females, and may present all the degrees of inconstancy and intractability which disorders called hysterical often exhibit. If not rendered inveterate by indulgence or habit, they may sometimes be resisted by an act of the will: we have known a most violent form of convulsive cough with stridulous breathing, which had resisted every kind of treatment, cured through the patient's hearing the actual cautery prescribed for the next attack.

The *treatment* of spasmodic affections of the larynx is to be generally conducted on the usual principle, of giving antispasmodics to remove or prevent the attacks, and improving the tone of the muscular system and diminishing nervous irritability by tonics, regular exercise in the open air, and other suitable means. Foreign bodies in the larynx and even in the œsophagus may excite violent and fatal spasm of the glottis. The treatment of this subject belongs rather to surgery than medicine.

2. *Atonic or paralytic affections of the larynx* are chiefly known by the symptom of aphonia, hoarseness, or some other alteration of the voice. This symptom is commonly connected with inflammatory or structural disease of the vocal apparatus: but even in these the sudden exacerbations show that much of it is nervous; and in nervous and hysterical subjects we not unfrequently find affections of the voice independent of any other disease of the larynx. Some persons not unfrequently lose their voice from sudden mental emotion, taking particular articles of food, menstrual irregularities, and other causes which operate on the nervous system; and the sudden manner in which they often regain as well as lose the voice, sufficiently points out the nature of the affection. We had the care of a lady, who from such causes is liable to lose suddenly not only her voice but also her power of articulation for days together, and to regain them as suddenly. For some time relief was instantaneously given, merely by her taking an electric spark with her fingers. This at last lost its efficacy, and even shocks failed; subsequently it was found that holding a lump of ice in the mouth was quite effectual. The complaint originated in a low fever, and the liability to its recurrence has diminished with the improvement of the general health under the use of mild metallic tonics with change of air. At present the attacks are rare, of short duration, and may be removed by drinking a little wine. The affections of the speech often preceding and accompanying general paralysis, are those of articulation rather than of the voice. But the voice is often changed or suppressed in attacks of violent palpitation, and particularly in cases of aneurism involving the arch of the aorta, the innominata, or right subclavian artery; and this circumstance is obviously referrible to the manner in which the recurrent nerves are stretched or compressed by these tumours.

Nervous aphonia is generally symptomatic of some other general or local disease: its treatment therefore must vary according to the nature of the primary affection. In the purely nervous or hysterical cases, the fetid gums and other

stimulants as temporary means, and a course of steel and other tonic medicines, with free exposure to a healthy air, the shower or plunge bath, and corresponding regulation of the mode of living, comprise the measures most likely to be successful. But sometimes either with or without those more remote causes, the local affection depends in great measure on relaxation or weakness of the muscles concerned in the formation of the voice. In such cases stimulant and astringent gargles, as of port wine, alum, infusion of rhatany root, or even a weak infusion of galls, will prove useful. The injection of a solution of sulphate of zinc or of nitrate of silver in the manner recommended by Trousseau, and described in the treatment of chronic laryngitis, would probably be still more efficacious. We have known several instances of clergymen, whose vocal organs have been weakened and relaxed by over-exertion, in which much benefit was derived from the use of astringent gargles. A piece of camphor kept in the mouth for some time before speaking is also of use. In some cases, the relaxation may be removed by the internal use of the balsams of copaiba or Peru. But unless there be a temporary suspension of all extraordinary exertions of the vocal organs, the effect of all these remedies will be very transient.

CATARRHAL INFLAMMATIONS.

Acute Catarrh.

General observations on catarrhal inflammations. — Symptoms of Acute Catarrh. — Coryza. — Mild Bronchitis. — Physical signs. — Causes. — Treatment.

By Catarrhal Inflammations of the air-passages is meant, those affections which are attended by an increased and altered secretion from the mucous lining of the tubes. From their most frequent cause they have received the common name of *colds;* and they are further distinguished according to their seat. Thus, in the nasal canals, the complaint is called *a cold in the head, coryza*, or *nasal catarrh:* in the fauces, it is *catarrhal sore throat*, or *cynanche;* whence it may branch off by the Eustachian tube, causing *deafness* and *earach;* or by the lacrymal duct, causing *catarrhal ophthalmia*, or *a cold in the eyes.* In the larynx and trachea, and its branches, it constitutes a *catarrh* or *cold in the chest:* in which case from its most prominent symptom, the complaint is called *a cough.* Although, by a few writers, this affection of the mucous membrane of the air-passages has been considered not to be essentially inflammatory, we do not hesitate to class it as such, for its course and phenomena are undoubtedly those of inflammation; and to reckon it otherwise, because there may be something specific and non-inflammatory in its origin, would be to follow a doubtful hypothesis, rather than plain fact.

The divisions which we purpose to adopt, are made with a view to important practical distinctions, rather than because they exist naturally; for the different affections, thus separated, pass by imperceptible gradations into one another. The more acute catarrhal inflammations of the air-tubes present especially two forms, which vary greatly in their severity, on account of their difference in extent and the situations which they occupy. 1. *Acute Catarrh*, which in the nasal passages is *Coryza*, and in the upper parts of the air-tubes a form of *Mild Bronchitis;* and, 2. *Bronchitis*, which affects the air-tubes more extensively, and by its effects interferes with the function of the lungs.

Symptoms of Acute Catarrh. The first symptom of catarrh, or, as it is popularly termed, *a cold*, is generally a feeling of fulness or obstruction in one or both nostrils, or a sense of tickling or relaxation in the throat, with an uncomfortable sensation in the stomach, approaching to nausea, and attended with flatulence; or, in those more liable to cough, it may begin with tightness and uneasiness in

the chest, with slight hoarseness, and irritation of the glottis. Any of these are commonly accompanied by some feeling of chilliness, occasionally with slight rheumatic pains, which are sometimes the first symptom, and indicate the general disturbance which precedes the localisation of the disease. As yet it may be uncertain what form the complaint may assume, although most individuals know from experience the course which it is likely to take in their own persons.

When it becomes developed as a *Coryza*, or cold in the head, there is a sense of fulness and obstruction of one or both nostrils, accompanied by the secretion of a thin colourless fluid. This flux comes on from time to time in an increased quantity, and the increase is always attended by an aggravation of the uncomfortable feelings of fulness and tickling, with frequent sneezing, and copious flow of tears from the eyes, which are full and injected: these effects show an acrimony in the discharge, as well as an increased sensibility of the pituitary membrane lining the nasal fossæ: this is further evinced in the progress of the disease, by the redness and excoriation of the end of the nose, and the skin above the upper lip. The senses of smell and of taste are always impaired, the latter often quite destroyed; there is often headach, or a sense of weight and heat over the brows, supposed by some to be occasioned by the catarrhal inflammation affecting the lining of the frontal sinuses. The partial or complete obstruction of the nasal passages, although caused entirely at this stage by the swelling of the membrane, gives the feeling of their being plugged up: and the same obstruction often renders the voice thick and nasal; subsequently it becomes husky from the swelling of the laryngeal membrane. If the attack be severe, there is fever, with loss of appetite, and pains of the back and limbs; and in almost every case an unusual degree of chilliness and sensibility to cold. The disorder is at its height generally about the third day, and then begins to decline; the flow from the pituitary membrane becomes more scanty and viscid, and less acrid, the lacrymation ceases, the swelling and obstruction diminish, while the headach and other symptoms proportionately abate, and between the fifth and seventh day the disorder may be entirely removed. Not unfrequently, however, fresh cold is taken from the slightest cause, and the coryza, with its attendant symptoms, is kept up for a longer time; and so long as the secretion is copious and thin, no amelioration of the other symptoms takes place. Still more commonly, as the irritation of the nasal passages subsides, that in the throat and larynx begins. The inflammation seems to be of the creeping or erysipelatous kind; and may wander along the Eustachian tube, causing dulness of hearing, perhaps with earach; along the fauces, causing sore throat; and down the œsophagus into the stomach, occasioning slight gastritic dyspepsia. Its more common course, however, is down the air-tubes, giving rise to the bronchial form of catarrh to be presently described.

Coryza not unfrequently attacks infants, and so obstructs the nostrils, as to interfere with the process of sucking, in which nasal respiration is necessary. The child leaves off repeatedly, becomes fretful, and sometimes purple in the face, in a few seconds after each time of taking the nipple. In children predisposed to convulsions, these efforts, and the disturbed circulation ensuing from them, sometimes prove the exciting cause of a fit.

When catarrhal inflammation extends to the upper bronchial tubes, constituting a form of *mild bronchitis*, it commences with coryza, or sore throat, and increases as the latter affections diminish; but in persons who are liable to coughs, it often is the first effect of exposure to cold. The first symptom is sometimes a feeling of coldness at the top of the sternum, with roughness or dryness in the throat, which occasions frequent attempts to scrape the throat. Then follow sensations of heat, tightness, soreness, or pain in the same part, with a cough, which is at first short and dry, but soon becomes longer, more urgent, and accompanied by the expectoration of a glairy, saline

tasted, transparent mucus. This secretion, so far from relieving the cough, obviously aggravates it by tickling and irritating the glottis, and probably possesses somewhat of the same acrid quality with that of coryza. This acrimony may be owing to the increased proportion of saline matter, which not only is evident to the taste, but has been chemically shown by Messrs. Brett and Bird to exist in the expectoration of bronchitis. The full development of catarrhal inflammation in the upper air-tubes is usually attended, especially towards evening, with quickened pulse, hot skin, and scanty high-coloured urine, with some degree of fever, and some shortness of breath.

The *physical signs* more clearly mark the condition of the bronchial membrane. In the earliest stage, perhaps, before any cough or other symptom of pectoral disease, various dry *rhonchi*, the *sonorous* and *sibilant*, with a diminution of the respiratory murmur, announce the narrowing of some of the air-tubes. More rarely, a total absence of sound in a part of the chest shows that the obstruction there is complete; while the unimpaired sound on percussion proves that the vesicular structure is free. These obstructions, no doubt, arise chiefly from the swelling of the mucous and submucous tissues, as we find the same take place in the nasal canals, when they are the seat of the kindred affection—coryza. Dr. Stokes supposes that a spasmodic constriction of the circular fibres, rendered irritable by the inflammation, contributes to the coarctation of the tubes. The bronchial tubes do not remain long in this dry state: the secretion commencing first gives a roughness to the other sounds, then adds to them a sound of bubbling, which is the *mucous rhonchus;* but this is seldom so loud as the other sounds, and when the disease occupies only the deep-seated tubes, it may scarcely be heard at all. According as the liquid is in the large or the small tubes, the bubbles, and the crackling which they produce, will be coarse and unequal, or fine and more uniform. The usual seat of all these sounds, in the milder forms of bronchitis, is in the middle parts of the chest, whether in front, behind, or at the sides, where the larger bronchi lie. The lower tones imply an affection of the larger tubes; but the acute notes do not indicate that the finer tubes alone are diseased, for they may be produced in the large tubes also, when the obstruction is considerable; and when there is heard an acute or whistling note prolonged through the whole act of inspiration or expiration, it may be known not to be produced in the finer tubes, because the air is not so long a time passing through them. The deep sonorous rhonchus, like the note of a violoncello, is probably seated at the branching off of a large bronchus; and so strong are its vibrations, that it may be often felt by the hand applied to the exterior, or by the patient, who can point out the spot where it is produced. These various sounds may accompany either the inspiration, expiration, or both.

The decline of this mild form of bronchitis is announced by a looser character of the cough, and a change of the expectoration to an opaque, thick, but less coherent phlegm, which is generally first perceived in the morning, that being the time when most inflammatory and febrile diseases show a tendency to remission. With this change, there is a general amelioration of the symptoms. The constriction of the chest is diminished or removed, the pulse loses its frequency, the skin becomes cooled by perspiration, the urine more copious and deposits an abundant sediment, and the decline of all the troublesome symptoms very generally corresponds with the altered character of the expectoration. This seems to have lost its irritating quality; is more tasteless; and comes up by easy coughing, in distinct pellets of opaque yellowish white or greenish white mucus, to which the soot and smoke of the air in large towns often give a grey tinge. Sometimes the sputa assume a consistent form without opacity, which renders the cough and expectoration easier, but it is not accompanied by the general improvement so remarkable when the sputa become simply opaque. In either case, the inspissation of the bronchial secretion causes some change in the physical signs; the bubbles are heard to break more rarely, and give more of a whistling or ticking sound; and the

sibilant and sonorous rhonchi become remarkable; but they change with every cough or forcible act of breathing. The same clots of mucus that by this partial obstruction to the air cause these ronchi, sometimes block up entirely one or more of the tubes, and stop the sound of respiration in the part to which the tubes lead. But this stoppage is seldom permanent; and a cough or deep inspiration will often open it or shift it to another situation, and the air is then heard to enter with a whistling or a clicking noise, where all had been silent before. The sound on percussion is still uniformly good; and this circumstance, with the varying respiration and rhonchi, characterises bronchitis in this stage.

Such is the ordinary course of the slighter cases of mild bronchitis, which may last from a few days to two or three weeks, but if neglected may continue for a much longer period, and assume a chronic form.

Causes. The most common *exciting cause* of acute catarrh, whether affecting the nasal passages or the air-tubes, is exposure to cold or sudden transitions of temperature. This cause is always more effectual when it is partially applied, as by standing or sitting in a draught of air, especially if the body be heated; by wet feet, or wearing damp clothing. Acute catarrhal affections often prevail epidemically, probably depending on sudden atmospheric changes, some of which are, obviously enough, those of temperature, but in other cases they are of a less intelligible kind, being perhaps connected with electric conditions of the air that elude our scrutiny. Certain it is, that the most severe and universal forms of epidemic catarrh have occasionally appeared without being preceded by equally remarkable transitions of temperature. An opinion prevails among many persons, that catarrh is infectious; this rests on the equivocal evidence of their so frequently affecting, consecutively, the different members of a household. A catarrhal affection of the eyes, nostrils, and upper portion of the air-tubes, very generally accompanies measles, and more rarely small-pox and scarlatina. Irritating gases, vapours, or dust, may excite catarrhal inflammation of the pituitary and bronchial membrane; but it is of a slight kind, and soon passes away, unless the cause be reapplied.

The only complication of acute mucous catarrh of the air-passages, which it is necessary to notice, is that with disorder of the gastro-hepatic function; in which, in addition to the catarrhal symptoms, there are headach, thirst, a loaded tongue, loss of appetite, occasionally nausea, or even vomiting, sometimes with tenderness at the pit of the stomach, or in the right hypochondrium; sometimes a slightly jaundiced skin and conjunctiva; and bowels constipated or irregularly loose, with dark or clay-coloured dejections. Dr. Copland mentions rheumatism as a disease with which catarrh is sometimes complicated, to which, he thinks, it bears some affinity. We have not observed this complication; and although there are occasionally slight wandering pains, like rheumatism, in the early stages of catarrh, they rarely take the course of true rheumatism.

Treatment. "A cold," which is one of the most common of all diseases, is rarely considered an object of more than domestic treatment; yet, trivial as it is, it is often formidable in its consequences. The ordinary method of treating a cold is, certainly, rather palliative than positively curative; but it generally mitigates its severity, and hastens its termination. A brisk purgative, conjoined, if there be febrile disturbance, with a moderate dose of calomel and James's powder, or tartarised antimony (the mercurial being increased and repeated in case of gastro-hepatic disorder), a hot pediluvium at night, confinement to a room of moderate temperature, or to bed in order to increase the perspiration, which may be promoted by warm diluent drinks, will generally serve to moderate the complaint. Temporary relief may sometimes be given to the headach and severe catarrhal irritation of the nasal passages, by holding the face, with the head covered with flannel, over a vessel of hot water; and, in the case of the coryza of infants, the repeated application of a sponge squeezed out of hot water will often succeed in freeing the air-passages for a time, and in thus enabling the infant to suck.

When the catarrh extends to the air-tubes, the same mild antiphlogistic plan may be pursued, with the addition, in more severe cases, of leeches above the top of the sternum, or a blister or tartar emetic liniment to the upper part of the chest, and the frequent use of a cough mixture, to diminish irritation and promote expectoration. Various combinations may answer for this purpose. Mixtures containing antimonial or ipecacuanha wine (♏x to ♏xx) with tincture of hyoscyamus or conium (♏xx to ♏xxx) or hydrocyanic acid (♏j), for the early stage, and with tincture of squill (♏x to ♏xx) and compound camphor tincture (♏xx to ♏xl), for the subsequent periods, generally answer well. But the efficacy of these remedies is decidedly increased by combining them with an alkali. From ♏x to ♏xx of the Liquor Potassæ, or an equal number of grains of carbonate of soda, or in more asthenic cases ♏xx or ♏xxx of the Sp. Ammoniæ Arom., are sufficient: in the greater number of cases, such alkaline remedies quiet the cough and promote expectoration far better than the oxymels and acid linctus or lozenges that are commonly in use. To have their full effect, cough medicines should be taken frequently, at least four or five times a day; for, besides that their object is to increase continually the secretion of the bronchi through the circulation, they seem to act, in some measure, directly on the glottis and its neighbourhood; and in the intervals it is useful to have in the mouth a demulcent substance, such as gum arabic, the solution of which tends, also by continuity, to sheathe these same irritated parts.

In order to insure the success of this mode of treating catarrh, more or less nursing and confinement is essential. To give diaphoretics and diluents, and at the same time to expose the body to transitions of temperature, which are almost unavoidable without confinement, will tend rather to increase a cold than to diminish it; yet few persons think it worth while to confine themselves for the sake of a cold, and thus either let it run its natural course, or make an even worse compromise, by nursing and sweating during one part of the day, and exposing and chilling themselves at another. Now, as these ordinary antiphlogistic means are inconvenient, and do not succeed in cutting short a catarrhal inflammation, there are other measures, which, if used at the outset of the disease, within a day or two of its commencement, often prove prompt means of arresting it altogether, or of bringing it to a speedy termination.

One of these methods is, by taking at bedtime, at the earliest stage of the cold, (whether the affection be felt in the nasal passages, the throat, the chest, or in the system generally,) a full dose of opium in some form, following it the next morning by a brisk cathartic. From ten to twenty grains of Dover's powder, or two grains of opium with two of ipecacuanha or a quarter of a grain of tartar emetic, or half an ounce of compound tincture of camphor, are the most eligible forms of opiate. It is safer to add a few grains of calomel or some milder mercurial, to prevent the restringent effect of the opium on the secretions. When the remedy acts well, the patient sleeps soundly, generally perspires freely, and awakes in the morning free from his cold, but often with some headach and nausea. These are generally relieved by a brisk purgative, and no further ailment is felt than a degree of languor which another night's rest may remove. This remedy seems to operate by deadening the morbid sympathies, and thus breaking the chain of actions on which the process of inflammation depends; as we find it cut short, in some cases of more serious inflammations, after the general vascular action has been reduced by bloodletting. Somewhat in the same way may be supposed to act the hot, spirituous, and vinous remedies which are popularly employed to check a cold; and which, hazardous as they are, were in some measure commended by Laennec. This kind of treatment may, however, prove injurious, where the digestive organs are weak, or where a tendency to other inflammations exists; and, by suppressing the expectoration, may change a bronchial catarrh into pneumonia.

Another method of stopping a cold is by abstinence from all kinds of liquid. This plan originated with the writer, who has practised it in his own person

for the last twelve years, with such success, that colds and coughs that used to continue for several weeks, have been generally cured in two or three days. It was first adopted especially in the treatment of coryza, in which, as the earlier stage of catarrh, it is the most successful; but it was soon found to be of great utility in catarrhal bronchitis. About six years ago, M. Piorry also recommended this plan as a means of diminishing the expectoration in various forms of bronchial disease; but it does not appear that he adopted it with the view of removing catarrhal inflammation. The great effect of abstaining from liquid food is promptly to reduce the mass of the circulating fluids. The natural fluid secretions continue, although in diminished quantity; the urine is still excreted, but its watery part is decreased; the skin continues to perspire, either insensibly, or obviously under the influence of increased warmth or exercise. This is not the case with the morbid secretion from an irritated membrane: the irritation is lessened with the decreasing fulness of the blood-vessels; the scantier circulating fluid being now taxed for the habitual and necessary secretions too closely to supply it, the morbid flux soon ceases, and the diseased membrane, no longer irritated by its own secretion, is restored to a healthy condition. If liquid be freely taken too soon, before the membrane has lost its diseased action, the discharge will return, and the complaint be as severe as ever. But if, when the discharge has ceased after twenty-four or thirty-six hours of abstinence from liquids, means be taken to keep up the natural secretions, as by exercise, with a warm state of the surface, a little liquid may be taken with impunity, the bulk of the circulating fluid being still below the amount at which it can readily supply any demand from the irritation of the diseased membrane. This is probably the physiological principle of the curative influence of the *dry treatment* on catarrh. It is very essential for its success, that it should be applied in the early irritative stage of the complaint; and it is most effectual when the catarrh affects chiefly the nasal membrane. If there be any fever, and especially if the state of the bowels require it, an aperient with an antimonial should be given; for this favours that free state of the secretions on which, as we have seen, the efficacy of the dry plan depends. In milder cases, this is not necessary. For similar reasons, it is desirable that the solid food be not of a too rich or heating kind; for this, undiluted by liquid, might be apt to disagree. Bread, or any consistent farinaceous food, with a little butter, vegetables, white fish, white or gelatinous meats, light puddings, and dried fruits, are suitable articles for a dry diet. Although a total abstinence from liquids is the most effectual, yet, taking about a tablespoonful of tea or milk with breakfast and the evening meal, and a wine glass full of water on going to bed, does not prevent the success of the plan, whilst it diminishes its discomfort. But the suffering from this voluntary privation is trifling in comparison with that from a severe cold; in fact, except with those who are habitually thirsty, it is rather negative than positive, arising from the imperfect enjoyment of eating without drinking. A great advantage of this plan is, that it does not interfere with common active pursuits, and needs no nursing or confinement. In fact, if care be taken to prevent the surface from being chilled, exercise in the open air promotes the success of the plan, by favouring the natural secretions. On the other hand, those who treat their colds by slops and diluents, which act chiefly by increasing the perspiration, will suffer from the least transition of temperature, which will have a greater influence on a freely perspiring surface. The time necessary to effect a cure by the dry plan will vary in different individuals, according to the present quantity of their circulating fluid, the activity of their secretions, and the intensity of the catarrhal disease; and also, somewhat according to the hygrometric state of the air, longer time being always required when the weather is cold and damp. On the average, forty-eight hours of abstinence will be sufficient. We have known thirty-six hours enough; but some severe and obstinate cases require three days. The period may gene-

rally be somewhat shortened by exercise and warm clothing, or lying in bed, or by commencing with a purgative, or by any other dry means of increasing the natural secretions. The catarrhal affection is generally much relieved at the end of the first day, and only troublesome at times; but the cure is not complete till all *stuffing* is gone, and nothing but a consistent mucus is formed, without irritation in the nasal or bronchial passages. Sometimes this secretion continues for a few days; but, unless fresh cold be taken, it causes no inconvenience, and soon ceases. In these cases, it is generally prudent to take an aperient and diaphoretic on returning to the use of liquids, which it is always best to begin at night, when there is less risk of relapse from fresh exposure.

BRONCHITIS.

Acute Bronchitis. — Sthenic and asthenic forms. — Symptoms. — Physical signs. — Infantile bronchitis. — Causes. — Symptomatic bronchitis. — Anatomical characters. — Diagnosis. — Prognosis. — Treatment of the sthenic and asthenic forms — of infantile bronchitis — of the various forms of symptomatic bronchitis. — Chronic Bronchitis. — General observations on chronic inflammation of the air-passages. — Characteristic symptoms of chronic bronchitis. — Causes. — Anatomical characters. — Prognosis. — Treatment of chronic bronchitis. — Diet and regimen.

Acute Bronchitis.

The more intense form of acute bronchitis differs from the milder kind already described, in the greater extent of the bronchial tubes which it occupies, rather than in pathological character. Its local nature and signs are the same; but its general symptoms differ, inasmuch as the system suffers more from the greater intensity and extent of the inflammation and of the functional disorder. This disease presents itself under two forms, long distinguished by the terms *sthenic* and *asthenic*. In sthenic bronchitis, inflammatory symptoms are marked from the commencement: there are generally pain, and constriction across the sternum; hard severe cough, with glutinous expectoration; much fever, heat of skin, thirst, headach, and scanty urine; white tongue, with red edges; quick and often hard pulse; hurried breathing, often accompanied with a feeling of great oppression; and cough on the least exertion. The pain in the chest is commonly referred to the sternum, and is more obtuse than the pain of pleurisy. The expectoration is usually scanty at first; afterwards it becomes more copious, glairy, frothy, sometimes streaked with blood, and its expulsion gives but little relief to the cough and breathing: it is compared by Andral to white of egg in different degrees of dilution, and from chemical analysis appears to contain free albumen, which is not present in healthy mucus: its quantity increases in the evenings, when there is a general aggravation of all the symptoms, more especially of the fever, dyspnœa, and cough. The physical signs are similar to those of the mild form; but they are here heard more extensively throughout one or both sides of the chest. The rhonchi are at first sibilant and sonorous; afterwards mucous and submucous, reaching to the inferior portions of the lungs, with a weakened respiratory murmur, announcing the presence of the inflammatory mucus even in the smaller tubes; but the clear sound on percussion declares the vesicular structure still free.

If relief be not afforded by expectoration, perspiration, or prompt remedial measures, the disease soon shows a change of character, from the increased dyspnœa, and symptoms of partial asphyxia that ensue. Then come on feelings of great depression; the pulse is weak, as well as very quick, and often irregular;

the functions of the sensorium are impaired or disturbed; the muscular strength is much reduced; the countenance becomes anxious, and pallid, or partially livid, according to the quantity of blood in the system; partial sweats appear; the pulmonary congestion becomes evident, by the slightly diminished resonance on percussion in the postero-inferior regions of the chest. The continuance of this state, and the imperfect arterialisation of the blood, further disturb other functions; the secretions become more scanty and vitiated; the tongue is loaded with a brown fur; the thirst is intense; and all these disorders concur in reacting on and aggravating the original disease, and in injuring the natural powers. Such is the loss of balance that results from the disturbance which severe bronchitis makes on the important function of respiration. The share which this function has in giving character to the constitutional symptoms, is seen in the fact, that very similar effects are met with in persons who have been subjected to an asphyxiating influence. The step from this condition to death is but a short one. In favourable cases, the disease declines between the fourth and the eighth days; the dyspnœa is diminished, and is confined chiefly to the evening, when there is almost always some tendency to exacerbation. The expectoration becomes opaque, and less glutinous and frothy; and on being voided, gives more relief to the cough and dyspnœa. The breathing becomes less laboured; the countenance improves, and resumes its proper colour; the symptoms of fever abate; and the disease either entirely subsides, or passes into a chronic form.

The chief difference presented by the asthenic or humid form of bronchitis (*peripneumonia notha*, as it was formerly termed), is, the early appearance of signs of depression, generally attended with gastric derangement; quick, wiry, often irregular and unequal, pulse; hot skin towards evening; headach, and thirst. Oppression of the breathing is here one of the earliest symptoms, accompanied by a peculiar wheezing; and, on auscultation, we find in the universal mucous rhonchus the proof of the early presence of a profuse secretion in all the tubes. The dyspnœa is liable to temporary exacerbations, which are often so severe as to prevent the patient from lying down, and are accompanied by extinction of the voice. During these attacks, there is sometimes some dulness on percussion, and occasionally even bronchophony in the posterior region on one side, which is removed with the decrease of dyspnœa. These probably depend on the quantity of liquid mucus in the bronchial tubes and cells; and on a temporary pulmonary congestion. The expectoration may be scanty at the outset, but afterwards becomes very copious and frothy. This form of bronchitis commonly attacks elderly people, those of a lax phlegmatic habit, and such as have habitually a cough with copious thin expectoration. In young children, a very fatal kind of bronchitis of the asthenic kind sometimes comes on in a most insidious manner. It may at first present the aspect of a common catarrh with coryza, without pain, much fever, or marked derangement of the functions. On attentive observation, however, the breathing is observed to be frequent, accompanied with wheezing, particularly before and after the fits of coughing; while the pallidity of the countenance, and heavy state of the child's spirits, indicate something more than a common cold. The cough is not always present; and as children do not expectorate, the disorder in the chest may escape remark, until the dyspnœa suddenly comes on and renders the danger imminent.

Causes. The most common exciting causes of severe bronchitis are the same as those of the milder form of the disease, from which, as we have before observed, it differs rather in degree than in kind: cold, particularly conjoined with moisture, applied locally or generally, as by wearing damp clothing, or exposure to a cold, moist, variable atmosphere, especially after the body has been heated by exercise or crowded rooms. Particular conditions of the atmosphere may excite sthenic bronchitis in those of an inflammatory habit; and the humid form of the disease in those of a more relaxed constitution. A severe kind of bronchitis often accompanies some of the eruptive fevers, measles, erysipelas,

small-pox, and scarlet fever, and causes the chief danger that accompanies them. In some cases, the recession of the rash is followed by great increase of the bronchial affection, which is announced by sudden and oppressive dyspnœa. From the suddenness of the production and disappearance of this symptom, which is occasionally observed in these cases, it is very probable that they are rather congestive than inflammatory; although, if the congestions continue, they take the form of bronchitis. Of the same character is the symptomatic bronchitis of continued fevers, in which the symptoms of the local disease are often so obscured, that it may run on to a fatal termination without being discovered, till its nature has been revealed by dissection after death. Auscultation in such cases, however, generally reveals the lesion — the sibilous, sonorous, and submucous rhonchi being heard in every part of the chest. Bronchitis supervening on erysipelas sometimes depends on the propagation of the inflammation by continuity, and may prove rapidly fatal. Erratic gout may manifest itself also in the form of bronchitis, which may be dangerous if the attack be sudden: in general, it vanishes quickly on the appearance of gout in an extremity.

The *anatomical characters* of acute bronchitis, as far as they present themselves, correspond with the indications of the physical signs. The lungs do not, in general, collapse on opening the chest, the escape of air being prevented by the obstructions in the bronchial tubes. These tubes, in most instances, contain a quantity of frothy fluid, similar to expectoration, before death: not unfrequently it is sanguinolent; but as this appearance is not often observed in the sputa, even at the last, it probably arises from an exudation of the colouring matter from the congested pulmonary plexus of vessels at the time of, and after, death. Purulent matter is frequently mixed with the mucus, especially in very acute sthenic cases, which have proved fatal in a few days. The bronchial mucous membrane presents various shades, from a light pink or crimson, to a deep or brownish red, either generally diffused, or in patches. It is occasionally found partially thickened, but much less commonly than might be expected from the character of the physical signs, which so generally indicate constriction of the tubes; but it is to be borne in mind, that the vascular injection and effusion, which chiefly constitute these constrictions, probably resemble those of erysipelas, which, it is well-known, disappear after death. Occasionally the mucous membrane is somewhat softened, so that it may be easily abraded; but this change is found by no means so frequently as in the gastro-intestinal mucous membrane.

Diagnosis. The distinctive characters of acute bronchitis are to be found in the leading general and physical signs of the disease. Its most important symptoms arise from its interfering with the function of respiration, and occasioning the circulation of dark blood through the system, with corresponding changes in the hue of the lips and cheeks, which result sooner from bronchitis than from other inflammatory affections of the chest. It should be kept in view, that more or less bronchial inflammation always accompanies these other pulmonary affections in their more serious forms, and is often the immediate cause of death. One of the most rapidly fatal forms of tuberculous disease, is that of abundant miliary tubercles, attended by a general bronchial inflammation, the secretion from which is the chief cause of the dyspnœa and suffocation which ensue. So also in continued fevers, as it has been pointed out, a secondary bronchial inflammation or congestion and effusion become a chief source of danger, although it may be difficult to distinguish it among the symptoms of the primary disease.

On the character of the sputa, a diagnostic between bronchitis and pneumonia has been founded: those of the former, although sometimes very viscid, wanting the rusty tinge which is presented by the expectoration of peripneumony. We shall see, hereafter, that hæmorrhagic engorgement, or a highly congested state of the lungs from organic disease of the heart, may add even this character to the sputa of bronchitis. But in bronchitis the air is not expelled

from the vesicular structure, as in the effusions of pneumonia and pleurisy: hence, although, from temporary congestion, the sound of the chest on percussion be sometimes impaired, it is not so to a great extent, or for a continuance; neither is there such condensation of the tissue, as to transmit the sound of bronchial respiration or bronchophony. The absence of the fine crepitation of pneumonia is a more equivocal test; but if observed, for two or three days, without dulness on percussion and rusty tinge in the sputa, it may be considered as pretty surely indicating that the parenchyma is not influenced. It is important to bear in mind, notwithstanding the artificial distinctions insisted on by Laennec and others, that the physical conditions of a congested lung with acute bronchitis, and of a lung in the first stage of pneumonia, are the same as far as regards their signs, and can be distinguished only by the different courses which they take, and which will depend on the degree of inflammatory tendency present, as indicated by the cough and general fever.

Prognosis. The tendency of acute bronchitis may be judged by the extent and stage of the disease, and the general strength and condition of the patient. When the inflammation is partial, affecting a few bronchi only, as in common mild cases, and without much dyspnœa and fever, it may terminate in a period varying from six days to three or four weeks; and its disposition to pass off is indicated by the expectoration becoming opaque and more clotted, and gradually diminishing in quantity. This change is always first seen in the morning; the evening exacerbations often restoring the thin glairy character to the sputa, even in cases tending towards convalescence. A relapse is marked by the expectoration resuming this condition, which is always accompanied by an increased hardness of the cough and fever. In the more extensive attacks of inflammation, where the dyspnœa is oppressive and constant, and particularly where the fever is high in the beginning, the prognosis must be very doubtful. If the acute symptoms have already yielded to the state of collapse, it may be feared that the power of the system will be insufficient to restore a function on which the disease has made a serious inroad. The extreme anxiety of the pallid countenance, with more or less lividity of the lips, of the face, and hands, coldness of the surface, and a rapid fluttering or thready pulse, announce the asphyxiating effects of this stage of the disease; and the universal mucous rhonchus becoming coarser and more gurgling as expectoration fails, with little or no respiratory murmur heard on applying the ear to the chest, gives direct evidence of impending dissolution.

In the severe bronchitis of children, the real amount of danger can seldom be estimated by the general symptoms, in time for the effectual application of remedies; but where auscultation discovers, from a widely diffused mucous rhonchus, that the inflammation is extensive, and occupies both lungs, great danger may be apprehended, whatever be the amount of dyspnœa and other symptoms at the time; for frequently these come on in paroxysms only, or are scarcely remarked in the somnolent state in which the child lies during the remissions.

The chief danger in asthenic bronchitis arises from the weakness or age of the patient. As long as expectoration continues free, and the strength keeps up, the lungs may be cleared of the secretion fast enough to maintain their functions; but the disease is often fatal to the weak, and especially the aged, whose lungs are generally more or less emphysematous, and therefore can ill afford any infringement on their function. One of the most fatal forms of bronchitis is that supervening on a suppressed eruption, or on erysipelas.

Treatment. As long as the *sthenic* character of bronchitis continues, there can be no doubt of the propriety of bleeding, more or less freely, by venesection, cupping, or leeches, according to the intensity of the symptoms, and the strength of the patient. In bronchitis, occasional moderate bloodletting (from 12 to 20 oz.) generally gives speedy relief, by removing the congested state of the lung; and in this respect bronchitis differs from pneumonia, in which this congestion is a more fixed part of the disease. It is desirable, however, to

produce an impression on the pulse, which often increases in fulness as the blood flows, while the temporary congestion is relieved. But inflammation of a mucous membrane is rarely removed by bleeding alone; it involves a certain structural change, probably interstitial effusion, that can be relieved only by a free secretion from the inflamed membrane. Expectoration is a necessary process during the remainder of the disease, and the strength should be saved for this purpose. In many cases, the local is preferable to the general abstraction of blood; and often they may be combined with advantage. The local abstraction of blood should be performed on the side in which auscultation discovers the greatest obstruction to the passage of the air.

In the earliest stage of the disease, the exhibition of a brisk purgative, containing calomel, is useful in assisting the antiphlogistic effect of the bleeding; but at a later period, strong purgatives do not act so favourably, and seem in some degree to check expectoration: a mild mercurial aperient every night is, however, generally useful.

To aid the antiphlogistic measures already named, certain internal medicines, which act especially on the vascular system, are of considerable efficacy. Tartarised antimony, in doses of from one eighth to one half of a grain every three, four, or six hours, with a drop or two of hydrocyanic acid, ten or fifteen drops of tincture of digitalis, or twenty drops of colchicum wine in camphor julep or other more agreeable vehicle, greatly contribute to reduce the intensity of the mucous inflammation, and to hasten its termination by expectoration. The efficacy of tartarised antimony in bronchial inflammation is much insisted on by Cheyne, Badham, Stokes, and others. If the cough is very hard and harassing, and is not sufficiently allayed by the remedies just named, it may be expedient to add something to diminish the nervous sensibility, such as hyoscyamus, conium, or belladonna. These drugs produce little effect, unless given in pretty large doses. Opium and the salts of morphia are not well suited to the early stage of bronchitis, as they tend to check expectoration. This objection does not, however, apply to the combination of opium with calomel, which is so efficacious in various inflammatory diseases. We have not found it equal to tartarised antimony, as a remedy for acute sthenic bronchitis; but it is a valuable resource where the latter disagrees on account of irritability of the stomach or great debility, and is more eligible where the bronchial affection is complicated with hepatic congestion and intestinal disorder. From one to three grains of calomel, or double that quantity of blue pill, or Hydrargyrum cum Cretâ, with from one fourth to one half of a grain of opium, and a grain or two of ipecacuanha, every three, four, or six hours, according to the symptoms, may in such cases be substituted for the liquid remedies; using, in addition, merely a little mucilaginous mixture, or some mild slightly alkaline linctus, for the cough, in which, if there be fever, a few grains of nitre and citrate of potass may be dissolved. The mercury may be withdrawn as soon as the gums show signs of its having affected the system, or it may be confined to a single dose at bedtime.

Blisters are not eligible for the early stage of sthenic bronchitis, from their liability to excite the whole vascular system before they rise, and consequently to increase the fever and bronchial inflammation. This effect is less likely to be produced by the tartar emetic applied externally, the operation of which, by particular management, may be so hastened as to be made available in acute diseases. For this purpose, the vessels of the surface should be excited by friction with a coarse flannel or a flesh brush, or by the application of cloths rinsed out of hot water, or by a short application of a mustard poultice. The tartar emetic should then be immediately rubbed in, either in the form of a warm saturated aqueous solution, or in that of an ointment composed of one part of tartar emetic and two or three of lard; and the application may be repeated in an hour, if a strong effect is desired. In this way, a full pustular eruption may generally be excited in as short a time as that required for the rising of a blister. We have often seen produced, in two hours, an intense

exanthematous redness, which in another hour or two became a thick crop of pimples, speedily running into vesicles and pustules. This form of counter-irritation is more intense and lasting than that from a blister, and is especially suited to give relief in the more sthenic forms of bronchitis with very viscid expectoration. It is probable that a minute quantity of the antimony enters the circulation, for nausea is sometimes felt; this result, instead of proving injurious, may be highly salutary.

When free secretion from the bronchial tubes has been fully established, and especially if it be more or less opaque, we may venture on remedies which are hazardous at the onset of the inflammation, — blisters and expectorants, even of a somewhat stimulating kind. The propriety of this change in the treatment has been ably pointed out by Dr. Stokes. Expectoration now becomes the chief mode of relief; and to facilitate this, the decoction of senega, with acetate or muriate of ammonia and tincture of squills, may be added to the tartar-emetic or ipecacuanha mixture before in use. Should a state of collapse come on, or symptoms of increasing debility threaten inability to expectorate, it is necessary to resort to more decided stimulants. Of these, the carbonate of ammonia is the most appropriate, as it rapidly enters the system, and seems peculiarly to assist expectoration. It may be given in doses of from two to five grains in decoction of senega, as frequently as the urgency of the symptoms indicate; and it should be withdrawn if there be a return of hardness of the pulse, or heat of skin. The tincture of the lobelia inflata may sometimes be advantageously added, in the dose of ten or twenty minims; but its action is uncertain, both in kind and in degree.

The good effects of the treatment will be apparent in the general symptoms, before they are evinced by the physical signs. The breathing becomes less laboured, the countenance improves, the pulse becomes more steady and full. On observing and listening to the chest, we may perhaps find that the air enters more freely into the lungs; but the mucous and other rhonchi are still present, and continue for some time; and it is only when the improvement is considerable, that we perceive that they diminish, and that the obstructions become less general; that, instead of bubbling over the whole, or a considerable portion of the chest, the respiratory murmur is heard, still mixed with clicking, whistling, and humming sounds.

In the *asthenic* form of bronchitis, the antiphlogistic treatment can be employed only to a limited extent; and the measures for the after stages of the sthenic disease may be used from the first. Bloodletting is scarcely borne, or only by leeches and moderate cupping. Dry cupping is occasionally useful; but the most available external remedies are blisters, which should be of large size. The mercurial or antimonial remedies, used in moderation, together with decoction of senega, an ammoniacal salt, squill, and compound camphor tincture, constitute the chief internal remedies useful in such a case. Where the depression is great, and the power of expectoration fails, besides the carbonate of ammonia it may be necessary to give other stimulants, such as æther, brandy, or hot coffee. In these cases, likewise, a certain degree of abstinence from liquids is expedient, not only by diminishing the mass of blood that has to pass through the clogged lungs, but also, as in acute catarrh, by reducing the quantity of the bronchial secretion. Dr. Badham recommends assafœtida in the occasional aggravations of the dyspnœa, which he supposes to arise from a temporary spasm in the bronchi. The asthenic form of bronchitis often leaves great weakness; and it is generally necessary to use tonics. If an irritable cough remain, it may be allayed by opium. Change of air will sometimes answer both purposes.

In the bronchitis of young children, emetics and mercurial purges are peculiarly serviceable. The former must not be too frequently used, as they cause considerable determination to the head, and exhaustion; but they are eminently successful in emptying the bronchial tubes of their secretion; and they probably do this, not only by the action of the external muscles of respiration, but

also by exciting the bronchial muscles to contract, as we know that the glottis is forcibly closed during the act of vomiting.

It is generally necessary to be particularly energetic in the treatment of bronchitis supervening on suppressed discharges and eruptions. Extensive counter-irritation with tartar-emetic is especially indicated in these cases.

In case of retrocedent gout, means should be taken to bring back the inflammation to the extremities, by hot pediluvia and mustard poultices; but these measures alone are not to be depended on; and it is proper to use colchicum with other internal medicines.

The bronchial affections occurring in the course of continued fever, are often rather congestive than inflammatory; and although they may greatly embarrass the breathing, the depressing tendency of the general disease prevents the employment of bloodletting to any extent. Leeches to the chest may be used in the early stages; but subsequently, when the low fever requires wine and other stimuli, the chest affection can only be treated with dry cupping, sinapisms, and blisters, and with moderate doses of tartarised antimony, or of mercurials, according to the symptoms.

Chronic Bronchitis.

Before entering on the consideration of chronic bronchitis, we shall make a few general observations on chronic inflammation of the air-passages. These are not separated from the acute by any very distinct line; although, when well-marked, they differ much from each other. The two forms may pass gradually into each other, and are often conjoined; for although acute bronchitis frequently exists alone, chronic bronchitis is rarely free from an admixture of acute inflammation. Neither is the long duration of the disease always a proof that it is not acute; for, in some cases, attack may succeed attack for weeks and even months, yet never lose the acute character. The character of the expectoration gives some proofs of the state of the membrane; and by its heterogeneous nature in chronic bronchitis, we may form a notion of the different pathological conditions simultaneously affecting the bronchial tubes in different parts of the lung. Perhaps the best test of the existence of chronic inflammation is that proposed by Andral — the continued presence of opaque matter in the expectoration, such as we have classed under the head of *albuminous*, whether it be muco-purulent, purulent, fibrinous, or caseous; whether these occur separately, or, as is more usual, are variously combined, of different degrees of consistence and colour, and occasionally mixed with a thinner and more transparent liquid of a mucous or serous quality.

The catarrhal inflammation of the nasal passages does not often present itself in a chronic form. If it continue, it loses the character of inflammation, and rather tends to become a kind of gleet or pituitous discharge, — a disease of secretion, coming on at intervals under the influence of various constitutional causes, in the manner of pituitous catarrh, which we shall afterwards describe. Sometimes we find persons complaining of an habitual stuffing or cold in the head, occasionally accompanied by a discharge of a sanious or puriform fluid; and, on inspecting the nostrils, the membrane is found red and thickened; but generally there is something to keep up this irritation, such as polypous growths or small ulcerations, which render the affection distinct from catarrhal inflammation, although it may occasionally originate in repeated attacks of this complaint. When the discharge has a fetid odour, it falls under the description of the disease called *ozæna*. This is, however, more commonly of specific origin, frequently depending on ulcerations or changes in the membrane of a syphilitic or herpetic character, from which, together with the continued action of the air, the fetor of the discharge probably arises. In young children, the coryzal inflammation shows more tendency to become chronic. It generally terminates in the formation of a thick sulphur-coloured mucus, which may continue for a considerable time, now and then becoming

more liquid, and either glairy or puriform. In infants, this complaint often causes great inconvenience and mischief, by interfering with the process of sucking.

The slighter form of chronic bronchitis is indicated only by habitual cough and expectoration, which are increased by sudden changes of the weather, and generally prevails most in winter and spring. It is most common in advanced life; in fact, few old people are perfectly free from it: in its slighter degrees, it may continue for many years, without materially injuring the constitution of the patient.

The more severe forms may succeed to an attack of acute bronchitis, which has lasted long enough to injure permanently the vessels of the bronchial membrane, its effects not having been controlled by treatment, or various causes having kept up a local irritation at the stage in which the membrane was relieving itself by an unusual secretion. In such cases, although the sputa have become partially opaque and clotted (or *concocted*, as the old writers termed it), and the usual mitigation of the fever and other symptoms have accompanied this change, yet the complaint then becomes stationary, with a lower febrile and inflammatory character, but with unsubdued and more paroxysmal cough, often with dyspnœa, soreness, tightness, and wandering pains in the chest, and more or less derangement of the general health. The sputa become diffluent, or of different degrees of consistence, and mixed with opaque clots of a yellowish or greenish colour, often with decided pus; sometimes they are streaked with blood, or of a dirty grey or brown colour, and partially transparent. When the expectoration is purulent and copious, there is usually much prostration of strength, and some loss of flesh; in some instances, with evening hectic, night-sweats, and other symptoms resembling those of pulmonary consumption, — but the physical signs are wanting. The chest, in simple chronic bronchitis, still expands equally, and sounds well on percussion; the respiration and cough are heard with various rhonchi,—mucous, sonorous, sibilant, and clicking, — which are continually shifting and changing. There is no bronchial or cavernous respiration; no permanent absence of respiration in a part; no unusual resonance of the voice; and, in spite of the continuance of the copious and puriform expectoration, on listening day after day, there are found no signs of a cavity, viz. cavernous rhonchus or pectoriloquy. Under these circumstances, whatever be the general symptoms, it may be pretty confidently pronounced that the disease is not tuberculous consumption, but simple chronic bronchitis. It is not, however, always very easy to get this perfect degree of negative evidence; and it requires much experience in auscultation, as well as repeated examinations, to pronounce confidently the diagnosis. In such and all doubtful cases, we should take also into consideration the history of the attack, the constitution of the patient, and such of the general symptoms as may serve to throw light on the prevailing tendencies of the system. The more profuse the expectoration, particularly if it be very purulent or otherwise albuminous, the less likely is the case to be one of phthisis, if no signs of this disease be found; and it may be the more readily inferred, that the sputa only proceed from a diseased membrane. But there may be another change induced, in consequence of long-continued inflammation of the bronchi, namely, dilatation; and this may produce physical signs, which may imitate those of phthisis.

Causes. Chronic bronchitis commonly arises from long-continued or repeated attacks of the acute disease, in the way already mentioned; but in old persons it may originate without any distinct prior acute attack.

An inveterate and formidable kind of chronic bronchitis is excited by the habitual inhalation of air loaded with dust. Needle-pointers, stone-cutters, those who powder and sift the materials for making porcelain, leather-dressers, and workers in artificial hair and feathers, are particularly liable to this affection. In these cases it begins with dyspnœa, which may continue for a considerable time before the disease declares itself. In the course of a few months,

however, the dyspnœa is increased, and accompanied by severe cough and copious expectoration, sometimes mixed with pus and blood. Not unfrequently the cough is accompanied with a profuse hæmoptysis. At this time the constitution suffers much: the pulse becomes quick; thirst and fever come on; the tongue is loaded; and the dyspnœa is more and more urgent, often attacking in paroxysms, attended by swelling and lividity of the face. The lesions in these cases, although beginning as chronic bronchitis, generally affect the structure of the air-tubes and pulmonary tissue, and terminate ultimately in various forms of pulmonary consumption. Unless the disease be early relieved by remedies, and a total abandonment of the unhealthy occupation, they become worse; the expectoration increases to a great extent, and becomes more purulent; hectic, with night-sweats, succeeds; and the patient ultimately dies with most of the symptoms of tubercular phthisis.

When chronic bronchitis occurs in early life, it generally follows hooping-cough, measles, small-pox, or some cutaneous eruption, and does not often succeed to the acute disease. It is generally a serious affection in young subjects, and is probably always accompanied or followed by considerable changes of structure in the bronchial tubes.

Anatomical characters. The mucous membrane of the air-tubes is frequently found of a deep red colour, which is either diffused or in patches, and of a more livid or violet tint than in the acute disease. Not unfrequently, however, there is very little redness: sometimes the membrane is even paler than usual; and this, in cases where there has been copious purulent expectoration. It is often thickened, particularly at the branching of the tubes, and the longitudinal and circular fibres under it irregularly enlarged in the manner to be afterwards described. Ulceration is not common in the smaller bronchi, except in cases of the disease arising from the habitual inhalation of dust, in which the whole mucous membrane of the air-passages is both ulcerated and thickened to a greater degree than in any other case.

Prognosis. The prognosis in chronic bronchitis depends very much on its origin, and on its being complicated or not with other disorders. When succeeding to an acute attack, and when unattended with much derangement of the general functions, it does not tend to a fatal termination. Even should there be purulent expectoration and some signs of hectic, a strong constitution and favourable circumstances often bring about a cure; and slighter forms of the disease, though obstinate and lasting for years, seem scarcely to abridge life. But in its worst character, with constant dyspnœa, copious purulent expectoration, hectic, and emaciation, especially if attended with symptoms of confirmed disease in the abdominal mucous membrane, in the liver, or in the heart, it is nearly as fatal as tubercular phthisis. In complicated cases, the bronchitis is often secondary; and there are abundant examples which prove that it may disappear entirely, if the primary disease be of a tractable nature and yield to treatment. In many instances, the prognosis must in great measure depend on the physical signs: the disease is itself an attendant on phthisis; and if these give the least suspicion that tubercles are present, the case must be considered of doubtful issue. The cases of simple bronchitis that prove fatal, are those in which the mucous membrane and other structures of the tubes have become so altered in texture and function, that the oxygenation of the blood is permanently impeded, whilst the copious secretion, and the perpetual wearing efforts to expectorate it, waste the body and reduce the strength. Such cases generally occur in aged persons, and in those already reduced by fever or some other severe disease. The imperfect oxygenation of the blood that results from extensive chronic bronchitis, occasions congestions in the lungs and heart: hence organic diseases of the heart, with effusions of serum and of blood, not unfrequently supervene on its long continuance.

Treatment of Chronic Bronchitis. In the administration of remedies in this, as in all chronic diseases, regard must be paid to the time required for the cure, and the strength economised accordingly. Unless in case of a temporary

increase of pulmonary congestion or aggravation of the inflammation, bloodletting is not necessary, for it has little power to control the action of vessels under the influence of chronic inflammation. Where needful, a few leeches under the clavicles, to the top of the sternum, or cupping between the shoulders, will generally suffice; or the existence of pain on either side may direct the place for bloodletting. The most generally useful class of remedies are counter-irritants conjoined with mild alterative tonics. Friction of the chest with an oily liniment containing various proportions of tartar-emetic, tincture of cantharides, the essential oils, ammonia, or acetic acid, or a diluted mineral acid, according to the effect desired, or a succession of mild blisters; or, in less severe cases, wearing an ample pitch or mercurial plaster, with a small portion of cantharides in it, will furnish a choice of means applicable to every case. The methods by friction are preferable to the use of plasters, for they tend to promote the respiratory movements; whereas plasters, unless they be supple and carefully applied, may somewhat restrain the expansion of the chest. To avoid this, the patient should be desired to take long deep inspirations when the plaster is first applied; and if its material be rigid, long cuts should be made in it, from the middle to the margin, corresponding with the intercostal spaces from the sternum to the sides. Dr. Stokes strongly recommends the following liniment as a rubefacient in chronic bronchitis:—℞ Sp. Terebinth. ℥iij; Acid. Acetici ℥ss; Vitellum Ovi j; Aq. Rosæ ℥iiss; Olei Limonis ℥j. We have used it with good effect; but have found a combination of ammonia with similar ingredients a still more permanent and energetic counter-irritant, such as the following:—℞ Liquoris Ammoniæ ℥ss ad ℥j, Olei Amygdal. ℥ss; Olei Terebinth. ℥iss; Aquæ Font. ℥ij; Olei Rosmarin. vel Limonis ℥j. M. We have sometimes employed with benefit a counter-irritant lotion, composed of a saturated solution of tartarised antimony with hydriodate of potash, in the proportion of half a drachm to the ounce, adding a little oil of turpentine or lemon to distinguish it as a liniment.

With external counter-irritation it is generally expedient to join such internal remedies as may seem best calculated to improve the condition of the diseased membrane, and of the functions generally. These must vary in different individuals; and although, in all these cases, the same local disease —chronic bronchitis — exists, yet they may be relieved by the most opposite means. Mild tonics, such as calumba and cascarilla with nitric acid, sarsaparilla, and taraxacum, are very commonly useful to improve the state of the secretions and functions in general; and where the expectoration is profuse and even purulent, without much vascular excitement, the mineral acids and metallic astringents in some cases, in others myrrh, copaiba, the balsam of Peru, or benzoic acid, prove occasionally useful. Many of these are safe and beneficial only when combined with external counter-irritation. With this safeguard, we have found that even steel medicines, particularly that most valuable preparation, the iodide of iron, may be borne, and have sometimes been very salutary in improving the general health and strength, without increasing the cough. The hydriodate of potash has been also found of service in some instances: it seems to restrain low degrees of inflammation affecting the fibrous parts of the air-tubes, and probably may in some degree retard the processes of induration to which they tend.

Of late years much has been said for and against the direct application of remedies to the bronchial surface, particularly of the vapour of iodine and chlorine by inhalation. This treatment, proposed some years ago by M. Gannal, a French chemist, has been used with some advantage by several practitioners. The chlorine or iodine is put in a liquid state into an inhaler containing hot water, and the air drawn into the lungs through a thin layer of this water is impregnated with an amount of chlorine varying according to the proportion of the ingredients used. In several cases in which we have seen this plan tried, the result has been unfavourable, the stimulating properties of the vapour exciting fever and cough, and the effort of inhaling fatiguing the patient. For

this method of inhalation might be substituted the diffusion of iodine or chlorine combined with aqueous vapour, either in the apartment of the patient, or, what would be more practicable, in a small room or closet cleared for the purpose, in which half an hour or an hour could be spent twice a day. This plan has been also proposed by Dr. Murray. Iodine or chlorine may be readily dispersed in any quantity through a room, by placing a few grains of the former, or a solution of the chloride of lime or soda, in a saucer floating on hot water. The quantity should be determined by the effect on the patient, always keeping it below that which causes much coughing or acceleration of the pulse. The inhalation of tar vapour has had repeated and extensive trials, since Sir Alexander Crichton first directed the attention of practitioners to it, and there has been some evidence in favour of its beneficial effects in certain cases of chronic bronchitis. As it is of a stimulating nature, like the balsams, it proves useful only in cases free from irritability or tendency to active inflammation: it is important to watch its effects when first employed, and to diminish or withdraw it altogether, if it continue to aggravate the cough and quicken the circulation.

The utility of expectorants in the chronic form of bronchitis has been questioned, because it is supposed that they might increase the secretion that is already redundant. But they probably exert, in many instances, an alterative rather than a stimulant operation on the bronchial membrane. Thus ipecacuanha, which seems to increase the expectoration in acute bronchitis, modifies and facilitates it in the chronic disease. In some cases, it may be given with great advantage in emetic doses repeated every two or three days: in some obstinate examples of the milder form of the disease attacking persons of robust habit, this practice has effected a cure. As an expectorant, it may be given in the dose of a grain or two of the powder or twenty or thirty drops of the wine, repeated several times a day, combined with squill, colchicum, camphor, and opium, or any other combination that the symptoms of the case may indicate. Squill is very useful in chronic cough unattended with purulent expectoration; and, in combination with colchicum, ipecacuanha, and a small quantity of opium, is often very serviceable in facilitating the expectoration and quieting the winter cough of old people. When the expectoration is viscid, an alkali should be added; and with a feeble state of the circulation, the carbonate of ammonia is the best. The tincture of the lobelia inflata has sometimes proved very beneficial in the occasional aggravations of chronic bronchitis, by relieving the breathing, and facilitating expectoration: but its operation varies greatly, sometimes causing giddiness and faintness in a dose of ten minims, sometimes giving relief only in doses of a drachm.

To diminish morbid sensibility, and allay that mobility of the muscular system on which the length and frequency of the fits of coughing depend, narcotics must often be combined with the preceding remedies. Unless for the sake of procuring a night's rest, opium should not be given alone, but combined with ipecacuanha, colchicum, or some of the other drugs which in some measure prevent its astringent effect on the secretions. The salts of morphia, *liquor morphiæ bimeconatis*, or the Tinct. Camphoræ Co., are in many cases more suitable than solid opium or its tincture. Conium in its extract is a very useful narcotic in chronic bronchitis, particularly combined with ipecacuanha, and, if the secretion be excessive, with benzoic acid also. The extract or tincture of conium has been sometimes used by inhalation: Dr. Stokes recommends ten or fifteen grains of the extract to be added to hot water in an inhaler, and the inhalation practised for a quarter of an hour once or twice a day. The extract or tincture of henbane, and the extracts of stramonium and of belladonna, are likewise occasionally beneficial. The latter is particularly serviceable where the cough has a convulsive character; and it should be given in large doses, such as a grain or two. In these convulsive cases, assafœtida and valerian have been found very serviceable. Hydrocyanic acid, the oil of bitter almonds, and laurel-water, which seem to owe their power to the same principle, also

sometimes give great relief to the cough of nervous subjects; but we have found them very uncertain.

Besides the means directed against the bronchial disease, it is of great importance to attend to the state of the functions in general. In febrile cases, the daily exhibition of a saline purgative is advisable. Should there be any complication with abdominal disorder, it is obvious that this should be attended to. Thus, when pain of the right side and shoulder, with perhaps fulness and tenderness in the right hypochondrium, stools of unnatural colour, a loaded tongue, and turbid urine, indicate disordered function of the liver and alimentary canal, it will be desirable to put the patient under an alterative course of blue pill and mild aperient medicines, in order to improve the functions of these important organs. Again, where a florid tongue, tender epigastrium, frequent thirst, dry skin, and nightly accessions of fever, indicate that the disease extends to the mucous membrane of the stomach and bowels, it is quite apparent that many of the remedies directed against the bronchial disease will not be borne, or will prove injurious, until the gastric disease be relieved by leeches and blisters to the epigastrium, followed by the mildest alterative aperients, with small doses of castor oil, and rigid regulation of the diet. Until this gastritic affection be subdued, the action of most internal remedies, even colchicum or opium, may be irritating. If due attention be paid to the removal of such complications, and if the disease do not present a decidedly inflammatory character, the weakness of the system may be combated by tonics, such as the sulphate of quinine, and the others before named.

Diet and regimen. The diet, in all cases of chronic bronchitis, should be mild and simple, and as nourishing as can be borne without disordering the digestive organs, or increasing the bronchial disorder. Farinaceous and milky food, with a little chicken or white fish, is best adapted to the plurality of cases; but those whose frames have been much weakened by age or by excesses generally require more substantial animal food, with a certain proportion of wine, which, like tonics, may be allowed with most safety where a counter-irritant is habitually used. It is scarcely necessary to insist on the importance of avoiding extremes and sudden changes of temperature, insufficient or damp clothing, and all those circumstances that are frequently in themselves exciting causes of the disease: when re-applied, they must necesarily prolong it; and not a few instances are met with, in which, owing to the nature of our climate, it is impossible entirely to avoid them. In these cases, in spite of the most careful administration of remedies, the disease persists; but a perfect cure may be effected by simple removal to a more genial climate. A warm sea-coast residence is the most beneficial, especially if the patient use regular and moderate exercise in the open air. When the circumstances of the patient do not permit the measure to its full extent, a change of air to the distance of a few miles may often do good, always preferring a sheltered situation with a dry soil. The careful regulation of the air in the apartments to which he is confined during the winter months, must be the resource of many in this country; and this can now be effected with the greatest precision and economy by means of Dr. Arnott's stove, one of the most valuable inventions of the present age. There must, however, be additional means to insure the ventilation of the rooms, which may be safely effected by a small fan-wheel in a window or door, so placed as to direct the current of fresh air to the ceiling, where it would mix with the warm air of the room, and occasion no draft.

In those predisposed to bronchial inflammation, the practice of daily sponging the chest freely with vinegar, or salt and water, contributes much to diminish the susceptibility to cold; and in the winter, the chest should be well-protected by a leather vest, as well as a long-sleeved flannel waistcoat.

BRONCHORRHŒA.

Symptoms, general and physical.—Causes.— Hay-asthma. — Anatomical characters. — Prognosis. — Treatment.

The mucous membrane of the air-tubes may be disordered in its function of secretion, independently of the process of inflammation; and, by the effects of the altered secretion as well as by the condition of the membrane itself, various groups of symptoms are induced. The most remarkable are those accompanied by excess and defect of the watery part of the secretion, constituting *Bronchorrhœa*, or *Bronchial flux*. That with excess is the *Humoral Asthma* of the older writers, and the *Pituitous Catarrh* of Laennec.

Symptoms. Bronchorrhœa generally comes on without any fever, in paroxysms of asthmatic or oppressed breathing, with cough, and the subsequent expectoration of an abundant thin frothy liquid, which appears to be the natural mucus diluted with a considerable addition of the watery part of the blood, with some portion of its saline matter. In some instances the affection extends to the nasal membrane, causing sneezing and a discharge from the nostrils, similar to that of a cold in the head; sometimes the bronchial and nasal affections alternate. The attack generally comes on rather suddenly in the evening, sometimes twice or oftener in the day, and may last from a few minutes to several hours: the dyspnœa is sometimes extreme; but the strength of the respiratory forces being unimpaired, the fluid is discharged by violent coughing as fast as it is secreted, and comes up clear, slightly viscid, and frothy, to the amount of a pint or more, leaving the patient almost free from complaint. On applying the ear to the chest at the commencement of the attack, various kinds of whistling, cooing, and sonorous rhonchi are heard; a little later, these become mucous and crackling or bubbling, and very little of the natural respiratory murmur is heard. The sound on percussion is generally pretty good; but in severe cases this is also impaired by the profuse quantity of liquid, which from the submucous and subcrepitant rhonchi may be known to extend even to the smaller bronchial tubes. As the coughing discharges this fluid, the respiratory murmur gradually returns; but even after the paroxysm is over, a good deal of whistling and wheezing may be heard in the chest.

Causes. This affection commonly occurs in persons of a relaxed habit, who have a languid circulation and are little disposed to inflammation. It appears to be frequently connected with long-standing disorder of the digestive or biliary organs. Laennec remarks that it is common in gouty subjects advanced in age, in whom the gout has become irregular and slight in its effects on the extremities. The causes which generally excite an attack are, exposure to sudden transitions of temperature, especially when the body is perspiring, disorders of the stomach and bowels, particularly from acid or acescent drinks, and other circumstances that tend to disorder the balance of the secretions and of the circulation. It sometimes arises from the unknown atmospheric influences, which develop common catarrh or bronchial influenza: in these diseases the pituitous catarrh often forms a most prominent and important pathological part, and it may remain after the febrile symptoms have subsided.

The *summer catarrh*, *hay-fever*, or *hay-asthma*, as it is termed from its supposed connexion with the effluvium of new hay, commonly presents the features of pituitous catarrh in the periodical and intermittent character of its attacks. After one attack, pituitous catarrh is very apt to recur; very slight causes, such as peculiar odours, close rooms, and trivial irregularities of diet being sufficient to re-excite it. In many cases however—from our own experience we should say in a considerable majority—bronchorrhœal discharges are secondary on organic disease of the heart, tubercles of the lungs, or some other

organic lesion, causing obstruction to the circulation through the lungs, the flux being a natural mode of relief to the over-distended vessels. Not unfrequently it accompanies or follows dry catarrh or bronchial congestion; and we shall presently find that the pathological difference between the two affections is not great.

Anatomical characters. The examination of the air-tubes of those who have died during a paroxysm of pituitous catarrh, discovers little or no trace of inflammation in the bronchial membrane. It is sometimes a little thickened and softer than natural, from the infiltration of serum; sometimes it is perfectly pale; sometimes a few lines or patches of vascularity are seen. The heart is commonly found more or less diseased, especially at the left auriculo-ventricular orifice; sometimes there is merely thinning of the walls. More rarely miliary tubercles are found in great abundance; and we have seen an instance of pituitous catarrh in connexion with malignant disease of the bronchial glands, which seemed to press on several of the great pulmonary bloodvessels. These several results, together with the transitory character, but long-continued recurrence of these attacks, the nature of the discharge, the absence of febrile and inflammatory symptoms in the subjects whom it affects, lead us to consider pituitous catarrh as a *profluvium* depending on a laxity, want of tone, or a mechanical obstruction of the pulmonary and bronchial vessels, rather than on an inflammation.

Prognosis. The importance of this affection varies much according to the state of the individual. When it attacks a subject enfeebled by age or disease, it may prove fatal in a few hours, there not being sufficient strength to discharge the suffocating accumulation of fluid in the air-tubes. Again, its long continuance, when it has by habit become established in the system, may waste the body, and by the struggle caused by its frequent attacks it may aggravate or induce disease of the heart, and lead to dropsical effusions and other serious symptoms of a breaking-up of the constitution. In other cases where the body is strong, or the disease slight, it may go on for years, impairing the comfort rather than destroying the general health of the individual. ts occasional occurrence may even prove salutary in cases of diseased heart, by unloading the engorged pulmonary vessels, and averting more formidable evils. Andral records an instance in which a sudden temporary attack of pituitous catarrh with very profuse discharge was attended with the removal of hydrothorax. In all cases the condition of the general health and of other organs, especially the heart and lungs, must be duly considered before a prognostic of the probable issue of the case can be safely given; and if there be found by physical examination that there is considerable disease of the heart, or a probability of the presence of tubercles in the lungs, the case will assume a proportionately unfavourable aspect.

Treatment. This affection is sometimes very obstinate, particularly when it has become established in the habit. The treatment should be considered in relation to the attacks of dyspnœa and expectoration, and to the condition of the system, and the pulmonary and general circulation, with a view to prevent the recurrence of the attacks. The chief indication, when an attack comes on, is to shorten its duration by diminishing the pulmonary congestion as far as possible by means of derivatives, and promoting the relief of what remains by measures which assist expectoration. From what we have already said of the nature and subjects of the disease, it may be inferred that bloodletting is rarely indicated. Immersing the hands and feet or even the whole body in hot water, or still better in a vapour bath, will sometimes, by deriving freely to the surface, much relieve the paroxysm of dyspnœa, and diminish the quantity of secretion which accompanies it; but to take effect, such measures should be employed at the earliest feeling of the asthmatic attack, and before the secretion commences, otherwise they only weaken the patient and scarcely shorten the attack. An emetic will often relieve an attack by determining freely to the surface, and by facilitating the discharge of any fluid which may have already

been secreted in the air-tubes; and some cases have been signally benefited by the repeated use of this remedy. Its violent and disagreeable action, however, precludes its employment in many cases; particularly in the weakly, and those labouring under organic affections of the heart. Laennec found tartar-emetic in large doses effectual in two cases in which suffocation was threatened. Ipecacuanha is however on the whole preferable, and when it cannot be borne as an emetic, it is sometimes useful in equalising the circulation and in promoting expectoration and perspiration. When the cough is very violent, it may be advantageously combined with hyoscyamus, conium, or small quantities of opium. In a few cases we have known great relief from the tincture of the *lobelia inflata*, in the dose of from twenty to thirty drops every hour or two hours, and increased according to its effects; but it is a very uncertain remedy, sometimes causing a most unpleasant giddiness and sickness in the dose of ten drops. In subjects that are very weak, with languid circulation, it may be necessary to give stimulants to support the powers of expectoration during the paroxysm. Of these, strong hot infusion of coffee is the best and the most harmless, but it is apt to lose its effect; and it may be requisite to substitute combinations of ether, ammonia, and camphor, with one of the remedies before named.

The most important object of the treatment is to prevent the recurrence of the attacks; and for this purpose constitutional measures are of more avail than those directed particularly to the lungs. Of the latter it may however be mentioned, that the habitual promotion of moderate expectoration by small doses of ipecacuanha and the balsam of copaiba or Peru, with alkaline attenuants and other remedies, recommended for bronchial congestion, may sometimes prevent that accumulation in the vessels that is apt to end in an asthmatic paroxysm. The occasional application of a blister will sometimes withdraw the irritation and flux from the bronchial surface. A course of aperients may also give temporary relief, particularly where the complaint originates in a torpid state of the bowels; but drastic purgatives should be avoided, for although they may for the time remove the pulmonary symptoms, they injure the tone of the digestive organs and insure the recurrence of disorder. In gouty subjects it is useful to increase the urinary secretion by a moderate use of colchicum with alkalies. But these measures are of little avail, unless attempts be made to improve the tone and balance of the vascular system by a mild but tonic diet and regimen. The diet should be mild and nutritive, consisting chiefly of farinaceous food and plain meat taken at regular hours and in moderate quantity. Spirituous and fermented liquors should be taken as sparingly as the previous habits of the patient and the present strength will allow. Liquids of all kinds should be used with limitation, and with due regard to the activity of the renal and cutaneous excretions. These should be promoted by regular exercise in a bracing but not a too cold air, care always being taken that the clothing is sufficient to maintain the temperature of the surface. Such measures will generally do more than drugs; but where they prove insufficient or cannot be fully adopted, benefit may sometimes be derived from a course of some mild tonic, such as calumbo, cascarilla, or even quinine with a mineral acid, or the sulphate of zinc in small doses, or one of the milder preparations of steel.

In cases of hay-asthma, Dr. Elliotson recommends the diffusion of chlorine in the air of the patient's apartment, by placing in it saucers, &c. containing chlorides of lime or soda. In three out of four cases, this measure afforded signal relief.

BRONCHIAL CONGESTION,

Its symptoms and physical signs.— Causes.— Anatomical character.— Prognosis. —Treatment.

Bronchial Congestion, or *congestive asthma*, inaccurately termed by Laennec *dry catarrh*, is another affection which exemplifies altered secretion of the bronchial membrane without inflammation. It is known more as an asthmatic than as a catarrhal affection.

The *symptoms* vary much according to its extent. In its slightest degrees it is experienced by many individuals, who only in the morning on waking feel their breath rather short until they have coughed up a little thick, tough, gray, semitransparent or dirty-looking mucus. In its severer degrees, that is, when more of the bronchial membrane is affected, the shortness of breath may amount to asthma, which comes on in paroxysms ending with hard dry cough and the expectoration of the scanty mucus before mentioned. Occasionally there may be also a thin mucous secretion; but this is not constant, and is obviously not the general cause of the dyspnœa. Sometimes there is little or no cough; and the dyspnœa or rather shortness of breath is not in fits, but may last for months and even years without other pectoral symptoms. If an attack of bronchitis supervene, there is a great aggravation of the dyspnœa, often amounting to severe asthma, and the symptoms of the two complaints are conjoined. But in simple bronchial congestion there is no fever, or sign of inflammation, but sometimes a sense of heat and constriction, or rather of stuffing, in the chest. There is often however much gastric disorder, with swelled and slightly furred tongue, relaxed uvula, and congested tonsils.

The *physical* sign of this disease is a more or less complete suspension of the respiratory sound in the part affected, whilst the chest at that point sounds well on percussion. This suspension is caused by the tumefaction of the bronchial membrane, which either of itself, or assisted by the scanty thick mucus before-mentioned, obstructs the passage of the air in ordinary respiration. Sometimes during coughing, or violent efforts of respiration, a clicking, wheezing, or sibilant sound announces that the obstruction is not quite complete; and some of the tubes will generally yield some of these rhonchi in common breathing. These signs, together with the character of the expectoration, will suffice for the diagnosis.

Causes. Excesses in diet, the sudden removal of cutaneous eruptions, suppressed gout, and sudden checks given to perspiration or any other free secretion, occasionally excite this affection. These causes operating on systems not much disposed to inflammatory reaction, such as those of a torpid habit of body, destroy the balance of the capillary system, and occasion an undue distension or congestion in certain parts of it. The same kind of passive congestion is sometimes more directly occasioned by organic diseases of the heart, particularly those in which there is some obstruction in the left ventricle; and these cases frequently are accompanied by the symptoms of dry catarrh.

Anatomical character. The membrane of the air-tubes is generally found of a deep red or violet colour, and sometimes partially tumefied, but without softening or ulceration. These circumstances, together with the sudden and intermitting character of the disease in some instances and its long stationary duration in others, seem to indicate that the affection rather belongs to the class of passive congestions which may be produced and removed, or endure for an uncertain period without that tendency to definite terminations which inflammations manifest. This congestion may doubtless sometimes originate in inflammatory affections of the same part; but according to our experience it is more commonly, as already stated, the result of disorders of the digestive or other organs, which tend to injure the tone of some or other part of the

capillary system; and when from prior tendency the bronchial membrane becomes its seat, its secretion is impaired and the symptoms above described are induced. Occasionally bronchial congestion is conjoined with bronchorrhœa: but according to the view which we have taken of that affection, the pathological causes of the two do not very widely differ, the same circumstances which cause a loss of tone in the capillaries being capable of either relaxing their exhalations, or dilating their caliber; or, what is more usually the case, some parts of the membrane are affected with one, and some with the other, and the result is the expectoration of much thin glairy fluid, with little pellets of tough mucus in it. So too by a modification in the properties of the congested vessels they may be excited or relaxed, and relieve themselves by the exhalation of their watery contents; and we accordingly sometimes find an attack of catarrh or asthma, at first quite dry, and devoid of any but the tough expectoration, suddenly relieved by a copious discharge of a thin frothy fluid. This happens commonly where the congestion is a mechanical result of organic disease of the heart.

Prognosis. Dry catarrh, although sometimes severe and difficult to remove, is rarely a dangerous disease, except in so far as it may be connected with organic lesions of the heart or extreme general debility. According to the extent of the bronchi affected, the disease varies from a degree not interfering with the general health to one amounting to severe asthma. Andral records two instances in which fatal asphyxia was caused by tough mucus that plugged up one of the great bronchi, and which no efforts of coughing were able to remove: but these are to be considered as accidental cases; and generaliy the expectoration comes at last, to the temporary relief of the breathing even in the most severe cases. But the continuance of the disease tends to induce permanent lesions of the pulmonary texture, particularly dilatation of the tubes and cells, which tend more constantly to injure the function of respiration, and sometimes eventually to destroy life.

Treatment. Depending, as this affection generally does, on constitutional causes, it requires general treatment as well as measures calculated to improve the condition of the affected membrane. A due management of the diet, avoiding all acid, rich, and irritating articles of food, the promotion and regulation of the excretions by the appropriate combinations of mild aperients and diuretics, such as blue pill, ipecacuanha, rhubarb, aloes, nitre, colchicum, &c. followed by mild alterative tonic medicines and suitable exercise, are the measures best calculated to restore and maintain that balance and tone of the sanguiferous system, which is incompatible with the congestive distensions of its parts.

With regard to the remedies directed to the congested membrane, it is not found that those useful in bronchitis are of much avail here. Bloodletting produces little impression. Dry cupping and other means of derivation are occasionally of more use. Stimulating applications to the surface of the chest, such as turpentine and vinegar or ammonia embrocations, or pitch plasters, or even dry rubbing, are frequently of temporary advantage. There are however means of increasing the bronchial secretion, and thus reducing the congestion, which, as temporary remedies, have considerable efficacy. We have before noticed the property which alkalies seem to possess, of determining to the bronchial surface; and we have now to notice in addition their attenuant or dissolving power, which diminishes the tenacity of the bronchial secretion, augments its quantity, and thus facilitates its expulsion. Their action is probably in great measure chemical. We know that alkaline remedies render the urine alkaline, and therefore increase the alkaline quality of the blood. Now there is no solvent of mucus more powerful than alkalies; and it is easy to conceive that an alkaline state of the blood can scarcely be compatible with the formation of tough solid mucus. Having followed the example of Laennec in using this class of remedies, we have found them very beneficial in promoting expectoration, and relieving the dyspnœa of dry catarrh. The Liquor

Potassæ (mxx to xl), carbonate of soda (gr. x to xx), or carbonate of ammonia (gr. iij to vj), may be given three or four times a day, with squill, ipecacuanha, or colchicum, and some narcotic, according to the general state of the system and the prevalence of particular symptoms. Laennec recommended also the use of alkaline baths, and of sulphur baths in cases complicated with cutaneous eruptions. The inhalation of the steam of hot water, alone or with camphor, tar vapour, ammonia, or any other volatile matter which may render it slightly stimulating, is sometimes of use. Some patients derive benefit from smoking tobacco or stramonium, particularly when there is also a tendency to spasm in the bronchi.

SPASMODIC ASTHMA.

Character and history. — Causes. — Diagnosis. — Prognosis. — Treatment. — Atonic or paralytic dyspnœa and its treatment.

The air-tubes are throughout endowed with nervous and muscular fibres, the functions of which contribute to the due performance of the act of breathing. The amount of the assistance which they thus contribute in health is not well known, but a morbid defect or excess of their operation is the cause of a peculiar class of affections of the respiratory organs of a nervous or spasmodic character, including *Laryngismus Stridulus* (Spasm of the Glottis), which has been already described, *Spasmodic Asthma* and *Atonic* or *Paralytic Dyspnœa, Hooping-cough* and *Neuralgia* or *Morbid Sensibility of the Air-tubes.*

Character and history of asthma. The term *asthma* is generally given to dyspnœa occurring in paroxysms. We have seen that attacks of bronchial congestion and bronchial flux may come on suddenly, last a longer or shorter period, and cease in such a manner as to merit the name of *asthma;* by which in fact they are generally known in this country. In the greater number of cases of asthma, there is reason to suppose that one or other of these affections or some degree of inflammation is present, and, by increasing the irritation or the irritability of the bronchi, causes an undue contraction of their circular fibres. An increased vascularity of the bronchial membrane may heighten its sensibility, and augment the contraction of those fibres that are in relation to it; and the same effect may ensue from the irritation of an unusual quantity or quality of the secretion within these tubes. So on the other hand the continuance of inflammation, the thickened and altered condition which it induces in the membranes, may tend to impair their sensibility, and injure in proportion the contractility of the air-tubes. In all these cases, the modification of the sensibility and contractility of the air-tubes is secondary to other lesions that are more essentially vascular.

But there are also cases of asthma of a purely nervous character; and this is sufficiently pointed out in the temperament of the patient, the nature of the exciting causes, the very sudden attack and removal, and the irregular duration of the affection. Thus it commonly occurs in nervous or hysterical subjects. The attacks are excited by strong or peculiar odours (such as the smell of a stable or of ipecacuanha), close rooms, sudden changes or particular conditions of the atmosphere, irritations of the stomach, mental emotions, disordered menstruation, and the like. These causes often suddenly bring on an attack, which, if severe, obliges the patient to assume a remarkable and very characteristic attitude. The body is bent forwards, with the arms resting on the knees; the chest is contracted, with the feeling of a tight cord or heavy weight upon it; the face is suffused, accompanied with an expression of great anxiety and distress; the veins are turgid, and the perspiration copious,

whilst all the muscles of respiration, ordinary and supplementary, are brought into full action in order to introduce air into the chest.

With what amount of success these efforts of respiration are made, may be known by applying the ear to the chest, where, in spite of the force of the motions, scarcely any sound of passing air is heard. The contractions of the muscles often give an external muscular sound; but within the chest there is only a very faint respiratory murmur, with occasional whistling or wheezing. The violent action of the muscles of inspiration seems to diminish rather than to increase the entrance of air: but when the efforts are less violent, especially towards the end of the paroxysm, now and then the air is heard to enter freely, as if the obstacle were suddenly removed, but at the next breath there is the same obscurity as before. At these temporary returns of the respiratory sound we must suppose that the spasm of the bronchial muscles is for the moment relaxed; and Laennec has pointed out a method of causing at will this relaxation, the consideration of which may be useful in enabling us to discover the nature of the disease. If we desire a patient who labours under the asthmatic spasm to restrain his efforts of breathing, and to hold his breath altogether for a few seconds, or, what amounts to the same thing, to count with his voice as many numbers as he can without taking breath, and then as quietly as possible to breathe again, the air will be heard to enter freely into every part of the lungs, but in a breath or two after the spasm regains its hold, and the respiration becomes as obscure as ever.

Laennec used to say by way of explanation that the spasm was thus overcome by *surprise*; but this expression gives no distinct physiological reason for the phenomenon. It does not seem to be explicable without assuming that there is a temporary relaxation of a tonic spasm of muscular fibres; and this relaxation we would ascribe to an increased degree of the same cause which usually induces the contraction of the same fibres. It is probable that the contraction of the circular fibres of the bronchi, excited by a certain degree of foulness of the air that is within them, is an essential part of natural expiration. Now the foulness of the air being increased by holding the breath long would stimulate these fibres to their utmost contraction, a contraction even beyond that of asthmatic spasm: their irritability is thereby for the moment exhausted, the spasm becomes consequently relaxed, and the air is heard to enter freely; but after a few moments' relaxation, the irritability is again restored, and, the exciting cause of the spasm remaining, the next breath may find the contraction as strong as ever.

The distinctive physical sign then of spasmodic asthma is imperfect sound of the respiratory murmur, *except after holding the breath*, when it becomes as loud as, or louder than, usual. The bronchial spasm is often of long duration; but it is liable to temporary increase, causing more decided fits of asthma in which the symptoms before described are manifested in the highest degree, and on their subsidence the patient is only short-breathed. When the bronchial spasm is considerable, especially in the paroxysms, the chest may sound ill on percussion, not with the absolutely dull sound produced when solid or liquid occupies the chest, but a short tight sound, like that which the chest yields on a forced expiration. This is caused by the contracted state of the lungs when under the influence of the bronchial spasm; the walls of the chest therefore being forced inwards by atmospheric pressure, are not so free to vibrate as usual, when this pressure is more nearly balanced on either side. A better sound may generally be obtained by striking on a finger or plexi-meter pressed on the chest strongly enough to exceed the contraction of the lungs. This contraction when excessive sometimes causes the diaphragm to rise higher than usual in the chest, leaving a remarkable hollow in the epigastrium, and gives to the whole chest a tight and contracted appearance.

We have remarked that those who suffer much from spasmodic asthma are seldom free from a shortness of breathing in the intervals; and the frequent recurrence of the paroxysms generally increases this habitual dyspnœa. If we

examine their chests, we find the same diminution of respiratory sound as during the paroxysm, but in a less marked degree; and the test of holding the breath proves that the spasm exists here also, having in a measure become habitual. The frequent recurrence or long continuance of these spasmodic contractions of the tubes must lead to permanent diminution of their calibre, and the other tissues become changed, and fix the tubes in this constricted size. We see the parallel of this in the irritable bladder, which, after long-continued attacks of spasm, at last becomes permanently contracted. Where the disease is purely spasmodic, this more lasting change might not ensue for a very long period; but with the spasm there is so commonly associated, either as cause or effect, congestion, irritation, or inflammation, that the phenomena and effects of these pathological conditions are very commonly combined with those of spasmodic asthma. Thus in asthmatic subjects, an attack of bronchitis, bronchial congestion, or bronchorrhœa, will be attended by spasmodic exacerbations; and a fit of nervous asthma which first comes on suddenly as a spasm, often terminates in a copious catarrhal secretion. The spasmodic constriction of the bronchial tubes, and the consequent violent yet ineffectual respiratory efforts, produce a congested state of the pulmonary vessels and partial obstruction of the circulation, which disorder the action of the heart, and may not be relieved without a free watery discharge from the bronchial membrane. On the other hand, asthmatic paroxysms are frequently associated with organic diseases of the heart. The congestion which these determine in the membranes and structure of the lungs, increases their sensibility and irritability; and where the circular fibres are naturally disposed to spasm, this congestion readily excites it; and the spasm may not be entirely relaxed until the congestion is relieved by free secretion from the bronchial membrane. So also, irregular gout, or the sudden suppression of an habitual discharge or secretion, or of a cutaneous eruption, may determine an irritation and congestion of the bronchial surface, accompanied by an asthmatic spasm.

Causes. In the preceding sketch of the history and pathology of the disease we have adverted to some of the causes which occasionally excite asthmatic spasm. But when the disease is purely nervous, there must be a condition of the nervous system in general, or of the nerves of respiration in particular, which gives the bronchial muscles unusual irritability. The nature of this condition is involved in much obscurity; but it may be classed with that which gives rise to many spasmodic affections of other muscles, which are called nervous or hysterical, and which not unfrequently occur in the subjects of spasmodic asthma. Hence violent mental emotions, long-continued illness, especially such as in itself or by its treatment tends to depress the tone of the system, menstrual irregularities, and particular states of the atmosphere, are among the circumstances which may predispose to, and even produce, spasmodic asthma; the predisposition is in some instances distinctly hereditary. In a few instances, spasmodic asthma has been more satisfactorily traced to a local cause of irritation, such as a tumour pressing on the pulmonary plexus, or on the par vagum, in some part of their course. Probably the remarkable influence which the state of the stomach and digestive organs often exerts on asthmatic affections may be also referred to irritation reflected through these nerves. In some instances too a source of irritation has been found in a diseased state of the upper part of the spine, occasioning pressure on the medulla or on some of those spinal nerves which, communicating with the great sympathetic, are also in relation with the nerves of the lungs.

Diagnosis. The sudden attack and removal of the paroxysms, together with the assemblage of physical signs before described, constitute the distinctive character of the disease. The slighter tonic or permanent spasm which may remain in the interval, and cause an habitual shortness of breath, may also be known by the respiration becoming distinct, not on increased effort, but after holding the breath, as well as by the absence of the signs of other lesions of the lungs or heart. The absence of fever also serves to distinguish it from

inflammatory diseases. From spasmodic affections of the larynx, it may be known by the absence of the peculiar hissing or stridulous sound resulting from the passage of the air through the constricted glottis. We have before remarked that bronchial spasm is generally associated with a congested state of the bronchial vessels, ending in secretion; and it therefore rarely happens that during the paroxysm, and especially towards its termination, there are not present also many of the signs of catarrh. So likewise where the asthma is symptomatic of disease of the heart, the signs of this, and of its various pathological effects, are combined with the asthmatic affection.

Prognosis. Spasmodic asthma, although most distressing and alarming in its attacks, is seldom fatal when uncomplicated with organic disease. It is probable that the spasmodic constriction, although sufficient to cause a painful feeling of suffocation in the lungs, which are perhaps unusually sensitive, always yields before the system can become injured by the imperfect oxygenation of the blood. The view which we have given of the temporary relaxation of the asthmatic spasm favours this supposition, and explains the well-known fact that spasmodic asthma is more distressing than dangerous. But as it is often complicated with other affections of the lungs and heart, or its frequent recurrence may tend to induce them, particularly dilatation of the air-cells, pulmonary congestion and hæmorrhage, dilatation and hypertrophy of the heart, &c., we are not to regard asthma as free from dangerous tendencies. We have known more than one case of hereditary asthma occasionally attacking an individual from the age of childhood to manhood, and terminating at the age of between forty and fifty in pulmonary consumption. In such cases tuberculous disease probably existed in a limited extent from a very early period; the asthmatic spasm occasionally supervening on it, and tending to increase it.

Treatment. This is to be considered in relation to the paroxysm and to the general state of the system in the intervals. The first indication is to counteract the exciting cause of the spasm, the second to remove this cause altogether or to lower the irritability on which it operates. 1. To relax the spasm of the bronchial tubes various measures may avail according to its immediate cause: when this is chiefly nervous, with little bronchitic or catarrhal complication, such antispasmodics as ether, valerian, assafœtida, opium, belladonna, and especially the fumes of stramonium, or tobacco, inhaled into the lungs, will sometimes succeed; each of these has proved more successful than the others in particular cases, but seldom retains its efficacy long. A more generally and permanently successful remedy is strong infusion of coffee, long ago recommended in this country by Pringle, and much extolled by Laennec. We have known some asthmatic patients, who relied so much on its efficacy, that the very idea of being out of the reach of it would be enough to bring on a fit; and they scrupulously avoided using coffee as an ordinary beverage, lest the habit of taking it should impair its efficacy as a remedial agent. This is a good rule, for this remedy is not free from the tendency of antispasmodics and narcotics, in general, to lose their power by frequent exhibition. In most cases it is easier to avert an asthmatic paroxysm than to stop or to shorten it when it has once begun. Hence, after previous experience has indicated the usual times and signs of its approach, the remedies before-named may be given with best advantage in anticipation of the attack. This is especially the case with the smoking of stramonium, which we have often found useful in this way, and rarely so after the fit has begun. In some cases sudden strong impressions on the system, such as dashing pails of cold water on the body, or passing slight electric shocks through it, have been known to stop a fit of asthma. Strong counter-irritants and revulsives, such as mustard poultices to the epigastrium, hot turpentine fomentations to the chest, and irritant pediluvia, in some cases give relief, but in others aggravate the symptoms. Emetics have the same uncertainty of effect. If the asthmatic spasm be complicated with an inflammatory or congestive state of the bronchial or pulmonary vessels, which is very frequently the

case, the treatment recommended for these conditions may be advantageously combined with some of the antispasmodics just mentioned: and when the nervous affection does not form the chief part of the complaint, it is probably dependent only on the altered condition of the membrane, which is either inflamed or congested; and to this condition therefore the remedial agents must be chiefly addressed. Under such circumstances depletions and other antiphlogistic measures which are rarely useful in purely spasmodic asthma become the best remedies.

2. The fulfilment of the second indication, to diminish excessive irritability of the bronchial muscles, and to remove the causes of irritation by which they are excited, will be best aimed at by various means which tend to restore a proper balance of the functions of the whole system, and to improve the general health. Of these the most effectual are those of diet and regimen. Particular rules can scarcely be laid down, and the experience of the patient is required to give a clue to the most eligible plan; but generally, a simple, light but nourishing diet, with great regularity as to hours, and moderation as to the quantity of food, will be the most suitable. The daily use of cold sponging to the chest, or the shower-bath if it can be borne, and of moderate exercise in the open air, avoiding walking against a strong wind, is generally beneficial. Of medicinal agents, besides those necessary to regulate the secretions, which always need attention, the metallic tonics sometimes prove useful in diminishing the morbid irritability of the bronchial muscles, or of the nerves that influence them. We have found in various instances the oxide and sulphate of zinc, the sub-nitrate of bismuth, the nitrate of silver, the milder preparations of iron, severally beneficial in diminishing the tendency to the recurrence of the paroxysms. Probably these remedies act through the nerves of the stomach, which are supplied by the same trunk (the *par vagum*), with those which influence the bronchial fibres; and they may do this directly, or indirectly, by improving the condition and function of the stomach, disorders of which in some form or other are commonly associated with spasmodic asthma.

The signs of improvement are (besides the less frequent occurrence and diminished severity and duration of the paroxysms) a more free state of the respiration in the intervals, so that the vesicular murmur is pretty audible without much wheezing, throughout the chest, and is increased in loudness by quicker and deeper inspirations, not stopped or impaired as during the continuance of the asthmatic tendency, when additional effort will often at any time excite the spasm. In the cure of this, as of other spasmodic disorders, it is very necessary to study the circumstances that excite the paroxysms in each case, in order to be able to avoid them; for the frequent occurrence of spasm increases the facility of its return, until it becomes habitual and may be excited under almost any circumstances. The evil of an habitual asthma is not only the inconvenience and distress occasioned by the paroxysm itself, but also the permanent changes which it may induce in the structures of the lung, such as contraction and rigidity of the air-tubes, congestions, emphysema, and other lesions of the parenchyma, and diseases of the heart and whole circulating system.

Atonic or Paralytic Dyspnœa. Hitherto we have considered only the *spasmodic* form of asthma, or that dependent on an excessive contractility of the bronchial tubes: but as in examining the elements of dyspnœa we found that *defect* of these properties would disorder the process of breathing, we are led to inquire whether there may not be a nervous asthma or dyspnœa of this kind from weakness or paralysis of the circular fibres, or of the nerves which regulate their contractions. We have parallel affections of the alimentary and urinary passages, when from local or general causes their moving fibres become torpid or paralysed; and if we are right in supposing that the action of the circular fibres, as well as the elasticity of the longitudinal fibres of the bronchi, be essential to the effectual performance of the act of expiration, defects of the properties of these tissues must cause a proportionate imperfection in this act.

We meet with instances of dyspnœa generally accompanying chronic bronchitic affections, but sometimes in hysterical females and other nervous subjects, in which this difficulty of expiration is the prominent feature; this part of respiration being wheezing, prolonged and attended with effort, whilst inspiration is comparatively short and easy. So also we see the defective action of the contractile fibres of the intestinal tube arise sometimes from previous over-irritation, and sometimes from more directly weakening or paralysing causes, and sometimes from that irregular distribution of nervous influence which produces the phenomena commonly called hysterical. Nay, if we consider that irritations first exalt, and afterwards injure, the contractile properties of hollow organs or tubes, and that these irritations or inflammations affect successively different parts of the same tubes, we can understand that spasmodic and relaxed asthma may co-exist in the same person, one part of the bronchial tubes being unduly contracted, and another unduly relaxed, from an irregular distribution of the property of irritability. This subject will be noticed again under DILATED BRONCHI AND AIR-CELLS.

Treatment. Depending as this affection usually does on previous inflammatory or congestive affections of the air-tubes, the remedies generally useful at the decline of those lesions are such as may be supposed to act in some measure by stimulating or giving tone to the bronchial fibres. Thus ammoniacum, benzoin, myrrh, the balsams of Copaiba and Peru, and the inhalation of tar and other stimulating vapours, besides their operation on the secerning function of the air-tubes, may probably have an influence of this kind on their moving fibres; and they may thus improve their powers in relation to the act of both expiration and expectoration, the difficulty of which often forms the most prominent feature of many protracted inflammatory and congestive disorders of the air-tubes.

HOOPING-COUGH.

Symptoms — Division into three stages. — Varieties and complications. — Causes. — Anatomical characters. — Nature. — Diagnosis. — Prognosis — Treatment.

THE disease known by the names *hooping-cough*, *pertussis*, *chincough*, *convulsive cough of children*, and which generally occurs once only during life, seems to combine several of the characters of inflammatory affections of the air-tubes with those of a nervous description, already adverted to, and, from its occasional severity and frequent complication with other serious diseases, merits careful consideration.

Symptoms. The simple or uncomplicated form of hooping-cough generally exhibits *three* stages: in the *first* it is inflammatory, a bronchitis or catarrhal inflammation; in the *second* it is both an inflammatory or at least congestive and nervous affection; in the *third* it is entirely nervous, although it may in some cases be complicated with alterations in the pulmonary structure. The *first stage* commonly begins as an ordinary cold, often accompanied with coryza, but there is more headach, languor, and often more febrile disturbance than usual; these symptoms sometimes precede the cough, which however begins earlier than in an ordinary cold. The general symptoms vary greatly in degree; being in some cases very severe, in others very slight, and not sufficient to require treatment. In the former case the pectoral symptoms are also very severe at first, with pain, soreness and oppression of the chest, dyspnœa, and other symptoms of severe bronchitis. The cough is at first hard, short, and ringing, being apparently excited by the irritation of a thin saline-tasted mucus in the glottis. The transition to the *second stage*, which commonly takes place in from four to eight days, is marked by the cough coming on more in fits and of a more

violent character. The tickling in the throat is less constant, but when it comes it cannot be borne an instant, but excites an uncontrollable cough, consisting of many repeated violent expiratory efforts followed by a long inspiration, which, by the hooping or crowing noise often accompanying it, may be known to be drawn through an imperfectly opened glottis.

The hooping depends on an undue irritability of the layrngeal and bronchial muscles, so that they do not relax, as usual, during the act of taking breath. But this sonorous back draught is not always heard in this complaint, particularly if the subject be not very young; and on the other hand it often accompanies other severe kinds of cough in children, in whom the aperture of the glottis is small and disposed to contract. This is further illustrated by the result of auscultation. On applying the ear to the chest of a child during a fit of hooping-cough, one is surprised to hear so little sound of respiration within the chest with all the violent external motions; and during the sonorous back draught, there is scarcely any sound of air entering the pulmonary tissue. This is to be ascribed to the continued contraction of the glottis and large bronchial tubes preventing the air from penetrating to the vesicular texture with sufficient force to produce the ordinary respiratory murmur; for in the convulsive cough of adults there is no obstructed hooping inspiration, but a full forcible one which is heard loudly in all parts of the chest. The other physical signs of pertussis do not differ from those of mild bronchitis; there being often variable sonorous, sibilant, and mucous rhonchi in the upper and middle parts of the chest. The fits of coughing generally terminate in the discharge of a thin glairy mucus; and such is the violence of the action of the abdominal muscles that the contents of the stomach are often forced up by it. This termination of the cough in vomiting is merely the result of the violence of the action which produces the cough: as soon as the muscular efforts have compressed the chest as far as it will yield, their force falls on the stomach, and in proportion as the cardiac orifice yields is the completeness of the act of vomiting. This disposition is increased by habit; and consequently as the disease advances the fits of cough often terminate more frequently and speedily by vomiting or retching. The violent and convulsive character of the cough is its most characteristic feature; the face and neck become red or purple, and turgid; the eyes are injected; the throat, chest, and abdomen are quite sore with straining, and the whole frame is so shaken, that the child is obliged to lay hold of something to afford support, and seems to be on the verge of suffocation. It is no wonder, that with such straining the expectoration should be sometimes streaked with blood, or that blood should flow from the nose; yet this does not happen very often, but chiefly in the plethoric, or in those predisposed to epistaxis, and, if not excessive, is salutary. No wonder too that convulsions, coma, and other cerebral affections, are sometimes induced in young and delicate subjects. At this time the violent paroxysms of cough sometimes cause mechanical injury of the apparatus of respiration and circulation: the air-tubes and cells become partially dilated or ruptured, the passage of the blood through the lungs is impeded, congestions are produced, the action of the heart is disordered, the foramen ovale may sometimes be reopened, giving rise to blue discoloration and œdema of the surface, &c. At this period in severe cases also there is often remittent fever at night; and with it there may be combined the various inflammatory complications in the chest, head, and abdomen, which constitute the chief source of danger in these cases in pertussis. We shall advert to these hereafter. In slight cases there may be no fever, and little functional disturbance in the intervals of the cough; but the common presence of the sonorous and mucous rhonchus, particularly before and after the cough, and the mucous expectoration in which the cough generally terminates, indicate that in all cases it is still a bronchitic or catarrhal as well as a nervous affection: and in fact, as this stage declines, the expectoration generally assumes the more consistent and opaque form which characterises the concocted sputa of a terminating bronchitis.

This change, which may occur from the third to the sixth week after the commencement of the disease, marks its transition to the *third* or purely nervous stage. There is great variety in its severity in different subjects: in some the convulsive cough may only come on twice or thrice in the twenty-four hours, and cease in the course of a few days: in others it rapidly loses its convulsive character and subsides like a common cough; in the majority of instances, however, it retains its convulsive character to the last, but becomes less frequent in its attacks, and ceases from six to ten weeks from the commencement of the disease. Delicate nervous children often suffer long and severely in this last stage, which assumes somewhat the form of a chronic convulsive disease; and even after it has itself ceased, for a long time it gives its character to any fresh cough that may be contracted from other causes.

Varieties and complications. The first or febrile stage of the disease is complicated occasionally with extensive bronchitis, and more rarely with pneumonia, pleurisy, or croup. These complications generally occur at times of the year, and in situations, in which such affections prevail; or they, as well as other complications, may be the result of individual predisposition developed by the fever which accompanies the disease. The greater intensity of the inflammatory and febrile symptoms, the more continued oppression and pain in the chest or throat, permanent frequency of the breathing and pulse, with the physical signs distinctive of these several affections, mark their occurrence. The cough becomes less violent and sonorous, but still frequent, and in the intervals the mucous or crepitant rhonchus is heard in the chest, or there may be partial absence of the respiratory murmur, with dulness on percussion. Less commonly the membranes of the brain are affected, and the grinding of the teeth, the rolling of the head, intolerance of light, contracted pupil, followed by squinting, vomiting, screaming, &c indicate the presence of acute hydrocephalus.

With any of these complications unsubdued by treatment the disease may prove fatal in the course of a few days with the usual symptoms of these affections. In the second stage the most frequent complications are partial pneumonia, hydrocephalus, and gastro-intestinal inflammation. Circumscribed or lobular peripneumony is a very common and fatal complication of severe hooping-cough among the children of the poor. It causes continued dyspnœa with quick pulse and hot skin, and crepitation or obstructed respiration and dulness in some part of the chest. Effusion in the brain may be apprehended when convulsions come on, or when between the fits of coughing the child rolls his head from side to side, with moans indicative of pain, or when he lies in a lethargic or half comatose state, with dilated or contracted pupil, strabismus, and paralysis or contraction of some of the limbs. This formidable complication is by no means uncommon in young children during the period of dentition. Gastric mucous inflammation is marked by the characteristic appearance of the tongue, continual thirst, occasional vomiting not excited by the cough, pain or tenderness at the epigastrium, looseness of the bowels, the stools being offensive, dark or clay-coloured; or in some cases constipation, scanty high-coloured urine, with burning heat coming on at night, followed by perspiration, progressive emaciation, &c. These signs of gastric irritation are sometimes combined or followed by those of inflammation and effusion in the head; or if this organ escape, and the abdominal irritation proceed, accompanied by the cough, it may terminate in tuberculous disease of the lungs or of the mesenteric glands. In these complicated cases, if the patient survive the dangerous lesions until the usual period of the third or nervous stage, the phenomena of this stage vary much according to the nature of the complication, the convulsive cough being sometimes absent and sometimes unusually severe in the cephalic cases; whilst those, in which the gastro-intestinal membrane or the lungs take on permanent disease, in some instances retain the convulsive character, and in others they present merely that of chronic cough.

Causes. Hooping-cough may occur epidemically, sporadically, or it may be propagated by infection. The latter cause is questioned by some writers,

but there is as much evidence in favour of the infectious properties of this as there is of any other disease, it having been known to spread among a family and neighbourhood from one case brought from a distant part; and its extension to other children being often prevented by their removal. It resembles the other contagious diseases of children in its rarely occurring more than once in the same individual. Like these, however, the disease spreads more rapidly under certain unknown epidemic influences; and passes by individuals in a manner that proves some bodily predisposition to be necessary for its production. Its epidemic prevalence has been frequently observed to accompany that of measles; the one disease sometimes succeeding to the other.

The period of life in which it most commonly occurs is between the ages of two months and twelve or fourteen years, but it occasionally happens before and after, and a few individuals escape it entirely. On the other hand, when it has occurred during infancy, it occasionally though very rarely recurs in after life. This happened to the writer, who suffered severely from a second attack in Paris in 1826, having probably contracted it during his attendance at the Hôpital des Enfans Malades. Mothers have also been known to have the disease a second time when suckling a child labouring under it. We have seen many instances in which adults, who in early life had pertussis, contract a cough of a convulsive character during the prevalence of the disease among children in the house. It has been occasionally observed when hooping-cough attacks adults, the paroxysms recur during the night only, interrupting sleep and exhausting the strength. In children also the paroxysms are often more frequent and violent during the night. The infectious properties of the complaint probably last during its two first stages, but this is very uncertain.

Anatomical characters. As hooping-cough rarely proves fatal, except in consequence of its complication with some other disease, it is not easy to learn from anatomy its essential effects. Most writers agree, however, that the lining membrane of the windpipe, from the epiglottis to its larger branches, is more or less injected and often covered by a thick mucus, and the bronchial glands are also red and much enlarged. Dr. Copland adds his testimony to that of Ozanam of Milan that the œsophagus also bears marks of inflammation; and he mentions having observed inflammatory appearances in the medulla oblongata and its membranes, even when there was no other remarkable lesion within the cranium, but he does not state what these appearances were. In the complicated cases, the common effects of inflammation are found in the organs which have been peculiarly affected. Thus in the bronchitic cases the bronchial membrane is much more extensively inflamed than usual, and the tubes are everywhere filled with spurious mucus, sometimes mixed with pus. The results of pneumonia are seen in the engorgement and hepatisation of portions of the lungs, in these cases often confined to lobules, particularly about their margin. In more protracted cases tuberculous deposits are sometimes formed, and the air cells and tubes are often irregularly dilated. Various products of inflammation are, in some instances, met with in the pleura and pericardium. When the head has been affected, serous effusion and opacity of the membranes have been seen in the brain, and rarely softening of its substance. When there has been remittent fever the mucous membrane of the ileum, cæcum, and colon is found inflamed, and occasionally ulcerated, and the mesenteric glands enlarged; in prolonged cases with a scrofulous tendency, tuberculous matter is deposited in these glands.

Pathology. There has been a great diversity of opinion respecting the nature and essential seat of pertussis. Cullen, Guibert, Hoffmann, Hufeland, and most other German authors, consider the disease as essentially nervous, depending on irritation (not inflammation) of various parts of the nervous system, particularly the phrenic and pneumogastric nerves, and causing spasmodic action of the larynx, diaphragm, and stomach. Leroi, Webster, and Begin ascribe the disease to inflammatory irritation of the brain and its membranes. Watt, Badham, Dawson, Dewees, Guersent, Laennec, and most other

French authors hold the disease to be essentially bronchitic or catarrhal, with the addition of convulsive action of the diaphragm and larynx, excited, according to some, by an excessive sensibility of the inflamed bronchial membrane. A third view, particularly maintained by Desruelles, is that hooping-cough depends on inflammation of the bronchi speedily causing irritation in the brain, whence is reflected convulsive excitement of the diaphragm, muscles of the larynx, &c. which gives to the cough its peculiar character. Dr. Copland considers the disease to be essentially a nervous irritation, commencing in the respiratory surfaces, and through the nerves, chiefly the pneumogastric, transferred to the medulla oblongata, whence it again affects the respiratory apparatus and sometimes the stomach; and that predisposing or concurrent causes may readily convert this irritation, at either of its seats, into inflammation.

In reference to these different views we may remark that in many instances they do not sufficiently regard the physiological character of those morbid motions which form the chief feature of hooping-cough. Thus we find much ascribed to the phrenic nerve and diaphragm, when it is obvious that these agents of inspiration are little, if at all, concerned in the motions which constitute the cough. We regard hooping-cough as originating in a specific irritation (almost always inflammatory at first) of the lining membrane of the upper portions of the air passages. This irritation is in the first stage constant, and accompanied with cough and expectoration, like those of common inflammatory catarrh; but in the second stage it peculiarly increases the irritability of the laryngeal constrictor and bronchial muscles, and of the nerves which excite the contractions of these as well as of the expiratory muscles which are sympathetically associated with them — those in fact which are concerned in the act of coughing. The peculiar cough of pertussis resembles that excited by a foreign body directly irritating the glottis; in fact it is properly called *pertussis*, for it consists of an exaggeration of all the actions of an ordinary cough and of nothing more; and there is no more reason for seeking its cause in the brain or spinal marrow, than there is for referring excessive vomiting or dysenteric straining to this seat. It is unnecessary to go further than the respiratory apparatus for an explanation of the phenomena of hooping-cough. The irritation which at first extends to the vessels and is more constant, becomes afterwards purely nervous, and, like other local nervous affections, such as neuralgia, spasms, nervous colic, &c., manifests its effects only occasionally, perhaps under the influence of some additional exciting cause. The various complications which so much increase the danger of hooping-cough, we would regard chiefly as the effects of the violent cough, sometimes assisted by predispositions to particular diseases or by co-operating causes. Any one who has witnessed the severe paroxysms of hooping-cough can scarcely wonder that it may produce in the head, in the lungs, and in the abdomen, serious congestions, which previous tendencies, or additional exciting causes, may readily convert into inflammation and its effects — hydrocephalus, pneumonia, and intestinal disease.

Diagnosis. The convulsive character of the cough, consisting of a rapid succession of violent short expirations, followed by a long inspiration, which is hooping in young children, forms the most distinctive feature of pertussis. Its termination in the discharge of glairy mucus, or of the contents of the stomach, also seldom happens habitually in other coughs. The convulsive or hysterical cough of adults sometimes exactly resembles pertussis even in the hoop; but the history of the case, and the alternation of the affection with other nervous complaints, will serve to distinguish it.

Prognosis. Hooping-cough, when occurring in children previously healthy, and not disposed to visceral disease, and when unattended with high fever at its commencement or with great violence and frequency of the paroxysms afterwards, is not a dangerous disease. But it is highly dangerous and destructive when, either from the delicacy or previous tendency of the subject, or

from the violence of the cough, it becomes complicated with inflammatory or congestive lesions of the head, chest, or abdomen. When, therefore, it attacks young children, under two years old, who are under the additional influence of the irritation of early dentition; or when it attacks children who are delicate from constitution or prior disease, or who belong to a family in which hydrocephalus or scrofula has prevailed; or when it comes on in any subject with high fever, difficult breathing, and other signs of complications; or when from the extreme violence and frequency of the cough these may be expected to ensue, — the prognosis must be expressed in terms of uncertainty.

Treatment. The three stages which the disease presents, form the ground of indications of treatment, varying as the complaint advances; and the complications, when present, will also furnish further indications. In the first stage moderate antiphlogistic measures; in the second, these in combination with expectorants and sedatives to allay the nervous and muscular irritability; and in the third stage, antispasmodics and nervous tonics,—form the chief indications of treatment of simple hooping-cough. In the milder cases, very trifling measures, such as an occasional emetic and mild aperients, and avoiding imprudent exposure when the weather is variable, may suffice; and, except in the early stages, confinement is unnecessary: in the severer forms, however, close attention to the symptoms will be required throughout the complaint.

The first stage is to be treated much in the same way as ordinary catarrhal bronchitis, which it resembles. Bloodletting only in the plethoric or when inflammation runs high, antimonial expectorants, and occasional mild mercurial and other aperients, are the chief remedies. If there be much heat of skin, a few doses of James's powder, or of an antimonial saline with nitre, should be given.

In the second stage, the antimonial expectorant may be continued with advantage; but it must now be combined with a sedative, to diminish the violence of the paroxysms of cough. These paroxysms generally terminate with the expectoration of glairy mucus; and, by favouring this secretion, antimonial or ipecacuanha wine in small doses, combined with an alkali, as in bronchitis, will generally shorten the duration of the fit. Full emetic doses have been very strongly recommended with the same view; but, except in case of accumulated bronchial secretion, we consider that equal benefit may be derived from expectorant or slightly nauseating doses, for they are far less weakening, and are quite sufficient to induce vomiting if that be desirable. Of sedatives, those most recommended are hydrocyanic acid, belladonna, and opium. The first has been highly extolled by Drs. Granville, Elliotson, and Roe; but its administration demands great caution, especially in young children, for its sedative influence affects the heart as well as the muscles and nerves of respiration; and the circulation of very young subjects, if suddenly depressed, does not readily recover its power. Belladonna has been much recommended by several continental practitioners. We have found it more safe and more effectual than prussic acid; and its dose may be considerably increased without any real risk. We have given a quarter of a grain three times a day to a child of two years old, half a grain to one of four, and a whole grain to one of eight years of age; and increased these quantities to double and more when they ceased to relieve. These doses generally cause dilatation of the pupil; and we conceive that the remedial agency of the drug depends on the same power to diminish the irritability in the laryngeal and bronchial nerves and muscles, which is thus evinced with regard to the iris. In a few cases there have been some feelings of heat and dryness in the throat, giddiness, and pain over the eyes; but these symptoms soon cease when the medicine is discontinued. They are more alarming than dangerous, for instances have occurred of upwards of a drachm of the extract being taken without any bad effects further than the continuance of these symptoms for a day or two. Belladonna often signally diminishes the violence and frequency of the paroxysms of cough; but as it is liable to lose its efficacy by constant use,

it is better to intermit it for a few days, and then resume it. In the more violent cases, it is necessary to resort to the stronger sedative — opium. It is best given in form of solution of one of the salts of morphia, combined with ipecacuanha and small occasional doses of calomel or hydr. cum cretâ. Its administration requires much caution in very young children and those with cephalic symptoms: in these it should be always combined with calomel. Syrup of poppies is objectionable on account of the uncertainty of its strength.

At the early part of the second stage, blisters are often beneficial, especially if there be more than usual bronchial inflammation: with young children they should not be left on for more than three hours. Afterwards stimulant and anodyne liniments rubbed over the whole chest occasionally prove useful. Camphorated liniment, with additions of oil of turpentine or amber and ammonia, may be applied. Tartar-emetic ointment has also been recommended for the same purpose; but it is less eligible, for the painful pustules which it excites prevent the continuance of the daily friction to which embrocations seem to owe much of their efficacy.

In the third stage, when the complaint is purely nervous, besides the sedatives and antispasmodic embrocations, another class of remedies becomes of great utility — tonics and even stimulants. Bark, myrrh, preparations of iron, arsenic, sulphate and oxide of zinc, nitrate of silver, assafœtida, musk, tincture of cantharides, and many other medicines of this class, have been much extolled by different writers; and each, perhaps, is occasionally useful in particular cases. In the choice of them, the practitioner must be guided by general principles or analogies. Thus in cases presenting a periodic character attended by debility, bark or arsenic may be most suitable: in those of a more convulsive type, assafœtida, musk, or tincture of cantharides, followed by the preparations of zinc or silver, may be found useful; whilst in cases decidedly asthenic, steel medicines are far more effectual. Of the latter, the ammoniated iron and carbonate of iron are generally the best preparations. M. Lombard of Geneva has recently written strongly in favour of the carbonate of iron, which he uses to the extent of twenty-four to thirty grains in the day even for very young children. In the employment of this and other tonic remedies, it is important to keep the excretions free; and to withhold the tonic, if there be any signs of obstruction, inflammation, or vascular irritation.

Diet and regimen. In the early stage the diet must be light, consisting of milk and farinaceous food. In the second stage white meat or jelly may be allowed; and children who are pallid may sometimes with advantage be permitted to take meat and the more nourishing articles. In the third stage the diet may be as in health. In the first or inflammatory stage of hooping-cough the child should be confined to the house and warmly clothed; and exposure of every kind should be avoided as much as in bronchitis. But towards the end of the second stage, when all feverishness and sharpness of the pulse have subsided, much benefit may be derived from the open air, and especially from a change of air. In the last stage, a change of air is almost a specific; any kind of change, and although only to the distance of a few miles, will sometimes entirely remove a cough that has baffled all medicines.

Treatment of the complications. When in the early stages of the disease, connected with its febrile onset, there are signs of inflammation in the head or chest, the appropriate antiphlogistic treatment must be employed, but not with the same freedom as if this inflammation were the only lesion. No antiphlogistic treatment will stop the course of hooping-cough; and a certain amount of strength must be reserved to support the patient through it. With this qualification we may refer to Acute Hydrocephalus and Pneumonia for the treatment proper in these complications. The congestive and inflammatory complications arising in the second stage from the violence of the cough and other concurrent causes, may be more successfully guarded against than cured. A few leeches to the head or chest, when any signs of congestion or irritation show themselves there, the occasional exhibition of mercurial aperients, the removal of dental irritation

by free scarification of the gums, and the continued use of measures calculated to diminish the violence and bad effects of the cough, constitute the chief means of preventing the production of serious disease. Of these, none is more important than the precaution of raising the child to a proper posture when attacked by the cough. It is a case in which a careful nurse is invaluable. The child should never be allowed to lie, or to hang its head down, during the severe fits. The paroxysms when very severe, and causing great turgescence and lividity of the face, may often be cut short by dashing cold water on the face, or by blowing into the ear. When once hydrocephalus or pneumonia has been induced, it must be treated, as far as the strength will bear, in the usual way; but from the weakness resulting from the previous disease, and from the repetition of the cough which it yet induces, these secondary forms of lesions are more fatal than when they occur idiopathically. Remittent fever, or other symptoms of gastric irritation, must be treated on the usual plan of mild alterative aperients, a strictly regulated diet, occasional warm baths, &c. In case of chronic bronchitis, pneumonia, or pleurisy, which in some instances succeed to hooping-cough, the treatment recommended for these affections must be adopted.

The convulsive cough of adults, not of a specific nature, is generally associated or alternated with other forms of spasmodic or convulsive disease, in which there is a great mobility of various muscles, an exaltation of the natural relation which subsists between certain nerves and the muscles which they influence. In several such cases, we have found extract of belladonna with the pilula aloës and assafœtida, and a galbanum or pitch plaister to the chest or back, give most effectual relief. Where the complaint is more obstinate, a course of the metallic salts, subnitrate of bismuth, nitrate of silver, sulphate of zinc or ammoniaret of copper, is often successful in removing it. They may generally be much aided by the shower-bath, country air, exercise, and other means which diminish the mobility of the nervous system.

Neuralgia, or Painful Sensibility, of the Air-tubes.

A pain in the larynx or under the sternum is sometimes produced independently of inflammation or any other affection. It is most commonly excited by breathing cold air, but sometimes comes on independently of any such cause. This morbid sensibility, although often, is not invariably accompanied by increased contractility. Spasmodic asthma, or spasm of the glottis, may be unattended with any other pain than that common to dyspnœa; and on the other hand, the weak or relaxed state of the bronchial tubes, marked by difficult or imperfect expiration, is sometimes accompanied by an increased sensibility of the bronchial membrane, so that the breathing of cold or irritating air becomes unusually painful. Under such circumstances the pain may be considered as nervous, depending on an excessive sensibility of the sentient filaments of the par vagum, like the gastrodynia and morbid sensibility of its gastric branch.

Treatment. The direct application of narcotics, by inhaling their vapour or smoke, will sometimes relieve nervous pain of the air-tubes. The vapour of hot water charged with camphor or conium with an alkali, smoking a cigar, or even holding in the mouth a lump of camphor or a warm aromatic lozenge, a bit of ginger, or a clove, will in some cases remove the pain, and enable the individual to take breath freely. Where cold air only excites the pain, a respirator, or some warm porous material held to the mouth, will prevent it. But it is better to attempt to reduce the morbid sensibility by the daily use of the shower-bath, or by freely sponging the throat and chest with vinegar or salt water, at first tepid, but after a few days quite cold.

STRUCTURAL LESIONS OF THE AIR-TUBES.

Hypertrophy and induration. — Dilatation, Contraction and Obliteration. — Ulceration. — Tumours.

Hypertrophy and Induration of the Air-Tubes.

Changes of structure in the bronchial tubes are most commonly the result of inflammation, or of some kindred modification of the nutritive process. Frequent recurrence or long continuance of inflammation of the bronchial membranes, as in other structures, changes their condition, and the mechanical forces to which they are subjected in the function of respiration may variously modify this change. The most simple change of structure is a mere thickening of the mucous and submucous tissues. This generally in some degree accompanies acute inflammations, but is then only temporary, and subsides as the secretion becomes free and albuminous; being caused, probably, by only an infiltration of the pores of the tissue with soft lymph, which, as the inflammation subsides, is eliminated and expectorated with the mucus of the membrane. The deposits that are the most readily produced by inflammation in highly vital tissues, are also the most readily removed; and thus it is that the soft albuminous matter that is effused by acute inflammation in cellular textures and in parenchymatous organs in general, if it be not so abundant as to compress the vessels, becomes absorbed as the inflammation subsides.

But it is otherwise when the inflammation recurs frequently, or lasts long; for it then causes an effusion less susceptible of absorption, involves the less vital structures; and as the changes induced are slow, so they are more permanent, because they become identified with the nutritive or reparative functions of these tissues. A degree of hypertrophy is then produced of some or all of the various tissues composing the tubes. Sometimes there is extraordinary thickening of the mucous membrane, so that it forms projections within the tube. More commonly, however, it is the harder and less vital textures that undergo the change, and its effect is to increase the rigidity of the tubes, so that there is a diminution of their expansibility and contractility. Nothing is more common than to find the air-tubes of persons who have long suffered from bronchitis, presenting an unusual development of the longitudinal elastic fibres. In other cases, the outer cellular coat of the larger bronchi is thickened and indurated, and their cartilages are sometimes partially ossified. Any of these changes has the effect of rendering the lungs less easily expansible in respiration: the first in particular is a common cause of the short breath from which persons frequently affected with bronchitis generally suffer; and although not often serious in itself, yet it may so abridge the sphere of the function of respiration as to make its increased exertion, during bodily exercise, a matter of difficulty and disorder, and to render it ill able to bear any other disease, to which the lungs can in general adapt themselves by supplementary efforts.

The chief sign of hypertrophy of the longitudinal fibres, and of increased rigidity of the tubes generally, is difficulty of inspiration, which is short, quick, and performed with an effort, especially on making any exertion; whilst the expiration is comparatively easy: but both acts are often accompanied by wheezing sounds from irregularities in the calibre of some of the tubes, and frequently from partial congestion or inflammation, from which tubes thus diseased are rarely free. The vesicular murmur is impaired, and the expansion of the whole chest is perceptibly limited. These signs resemble those of spasmodic asthma, except that they are permanent, and are not removed as the latter may be, for an instant, on breathing after holding the breath in the manner before described.

Inasmuch as these lesions seem to arise from continued inflammation, it becomes of the more importance to direct remedies against those forms of bronchitis that are habitual or frequently recurring. An imperfectly cured cough will often harass a patient for months, and even for years. In process of time the breathing becomes permanently shortened, and an irritation is often fixed in some of the tubes, manifesting its effect on their secreting function by habitual expectoration, generally thin and mucous, sometimes muco-purulent. This affection varies greatly in degree. We have known several cases of habitual dyspnœa, presenting the characters now described, ultimately prove fatal, and after death no other lesion discovered than a general redness of the membrane lining the larger tubes, and an extraordinary development of the longitudinal fibres. There is one point with regard to treatment particularly suggested by a knowledge of this change of structure, that not only should the practitioner persevere in the use of the means which tend to eradicate the low degrees of inflammation that produce it, especially alkaline expectorants and counter-irritants, but he should also endeavour to countervail, by *mechanical* means, that mechanical limitation which this change induces in the size of the tubes. If the patient use no exertion and give his lungs little play, any increase in the rigidity of the tubes will more readily fix them in their present contracted state; but if he take moderate exercise, increased as habit improves his power, the lungs will be kept in that free mobile condition that is least favourable to rigidity or deposition of any kind. Probably special efforts of inhalation would be useful with the same view; and as this might be combined with some mildly stimulating vapour, such as that of water impregnated with tar or camphor, it might be also serviceable in improving the secreting properties of the membrane. It is obvious, however, that great discretion is necessary in the employment of these mechanical means, for if they strain the tubes beyond the due limits, they may cause a morbid yielding of the walls, and increased inflammation; and if exertion be used beyond what the function of circulation can readily support, it will occasion congestion in the lungs, which may aggravate the original disease, and induce lesions of other kinds. These mechanical measures are more adapted for young than for old subjects; because in the latter the change is more likely to be permanent, under the influence of that general law by which, as age advances, fibrous tissues tend to assume a cartilaginous hardness, and cartilage becomes rigid with osseous matter.

Dilatation, Contraction, and Obliteration of the Air-Tubes.

On examining the lungs of patients who have long suffered from complaints of the chest, it is not uncommon to find the bronchial tubes, when laid open by a pair of scissors from the large to the smaller branches, exhibit dilatations of different kinds, the enlargement being usually most apparent in those parts of the tubes where the cartilaginous plates are small and few; but occasionally the larger tubes are also dilated, their rings only here and there limiting their dilatation. Sometimes the dilatations are pretty uniform through some length of a tube; in other cases they form irregular roundish cells or pouches, freely communicating with each other, from which other tubes arise either dilated or undilated. The tissues surrounding the tubes are generally more or less altered. They are least so in the uniform or tubular form of dilatation, in which the coats are often quite thin, and the longitudinal fibres distinct, although occasionally enlarged. But in the more globular or cellular dilatations, the walls of the tubes are commonly much altered; they are irregularly thickened, the thickening being formed in part by hypertrophy of the mucous and submucous tissues lining the tubes, and partly by a dense tissue on their outsides, probably consisting of the parenchyma of the lung compressed by the encroaching tube. There is little or no trace of the longitudinal or circular fibres in this form of dilatation, and the lining membrane is generally in a softened state and of a red colour,

whilst some parts of the tubes are quite rigid. We shall better understand the pathology and signs of these lesions by examining a little into their causes.

Laennec, who first described dilatation of the bronchi, ascribed it to the frequent accumulation of mucus in the tubes, causing their mechanical distension. He considered that they were formed especially by long-continued chronic bronchitis, and that the continual recurrence of the same distension of the tubes led to their permanent dilatation. But this view is by no means sufficient to account for the remarkable changes which we frequently see in the structure of the dilated tubes; nor do these lesions constantly occur where the bronchial secretion is copious, and most calculated to cause distension. M. Andral takes a more rational view in ascribing these lesions to a modification in the nutrition of the textures composing the tubes; but he does not attempt to explain the mode in which the change is effected. If, however, we bear in mind the details of the internal mechanism of respiration, and the manner in which they may be deranged by disease in the various textures concerned in them, we shall find no difficulty in tracing several causes of dilatation of the air-tubes, as well as an explanation of the changes in their tissues and those of the surrounding parts. A mutual pressure is continually exerted between the interior of the bronchial tree and the air: in inspiration, by the air which enters to distend the tubes; in expiration, by the tubes contracting to expel the air. In forcible acts of respiration, such as coughing or energetic breathing, this pressure is increased; but in the normal condition of the tubes when they all equally and freely convey the air to and fro, and meet the pressure with a well-proportioned degree of elasticity and contractility, this pressure is balanced and borne well. But if in any way the equality of this pressure be disturbed, or those elastic and contractile properties that are opposed to it be deranged, it becomes converted into a cause of unnatural distension in some parts, while it does not reach others with sufficient force. There are several conditions which may cause these disturbances, and they are especially to be met with in those diseases which are known to lead to dilatation of the air-tubes. Bronchitis may act in both these ways: by thickening of the membranes or by viscid secretions, it may cause partial or complete obstructions, which, by preventing the free entry of air into some tubes, increase its pressure into others, which become distended in consequence; and it may alter the condition of the tissues composing the tubes, so that, losing their elastic and contractile properties, they yield to the pressure and become fixed in this dilated condition. Perhaps, as Dr. W. Stokes has suggested, the mere loss of contractility may in itself be sufficient to cause dilatation of the bronchi; but our view will be more satisfactory if we take into consideration that this distending force is applied to textures softened and otherwise modified by inflammation, and that the change may thus become perpetuated and combined with other alterations in the textures affected. Hence the lesions are often not simple dilatations of the tubes, but comprehend also irregular softenings and indurations, atrophy and thickening of their several textures; so that when the lung is cut open after death, it may be at first difficult to discover that the irregular cavities and indurations which it presents are formed by dilated tubes. Then in the production of these dilatations we are not to forget the influence of violent acts of respiration. They have been observed to succeed to hooping-cough, and other bronchial affections in which the cough is particularly violent and long-continued. But we have met with cases of dilated bronchi in which there had been very little cough, and none of any violence; and here we must suppose that the other causes, the irregular introduction of air, and the partial yielding of the tissues, were more exclusively concerned in the production of this lesion. Of this kind are the following cases. In pleuro-pneumonia, the lung is inflamed and at the same time compressed by an effusion in the sac of the pleura: if it remain long in this state, the smaller air-tubes and cells become obliterated by the adhesion of their sides, so that when the liquid is removed from the pleura, they will not expand again with

the enlargement of the chest; but the large and middle-sized bronchi are not obliterated,—they bear the whole force of the inspired air, and become consequently dilated by it. These cases, although not uncommon, were not noticed by any writer, until described in the author's lectures published in the *Medical Gazette*. Dr. Corrigan has since described cases of dilated bronchi, which seem to be of the same character, although he refers them to the production in the lung of a new contractile tissue, like the cirrhosis of Laennec. We doubt the propriety of giving such a name to a lesion which seems to be the result rather of inflammation modified by the circumstances of compression or of slow progress, than of a peculiar production like the cirrhosis of the liver. Other lesions which cause the obliteration or obstruction of a considerable number of tubes and cells, tend to produce dilatation of the adjoining tubes, on which the motions of the chest act with augmented force. Thus it was observed by M. Reynaud, that when bronchial tubes become obliterated in consequence of the effusion and organisation of lymph within them, (a result connected with pneumonia rather than bronchitis,) they are sometimes dilated up to the obstruction, and the neighbouring tubes and cells commonly so. The same result is not unfrequently observed in connexion with tubercles which press on some tubes or obliterate the cells to which they lead. Larger tumours, such as aneurisms and cancer of the bronchial glands, pressing on one of the great bronchi, in a similar way cause unusual distension of those parts of the lung to which the other bronchus leads.

The symptoms produced by dilatations and contractions of the bronchi vary according to the extent of the lesions. Slight degrees of them are met with in the bodies of persons who had not during life manifested any prominent disorder of the respiration; and their simpler forms may exist to a greater extent without producing other effect than a liability to attacks of bronchitis. But where many tubes are affected, their structure modified, and much of the vesicular parenchyma obliterated in consequence, there are then produced habitual dyspnœa, with more or less cough and muco-purulent expectoration, which is often remarkable for its fœtor. The ordinary symptoms of severe chronic bronchitis, from which some of the affected tubes are scarcely ever free, are generally present; and the permanency of these symptoms, together with a degree of lividity, dropsical effusion in different parts, and cachectic condition of the whole frame induced by the crippled state of the lungs, constitutes the usual general character of the aggravated forms of dilated bronchi.

The physical signs of dilated bronchi are very intelligible. The air passing through them in respiration causes a louder, hollower, more blowing sound than in those of the natural dimensions; hence a kind of tracheal or cavernous respiration is heard over them in regions where naturally the respiration is vesicular; and if, as it frequently happens, there be liquid in the tubes, the bubbling into which it is thrown will be coarse and gurgling, instead of the finer mucous rhonchus of common bronchitis. So also the voice may be powerfully transmitted through these enlarged tubes, not as usual in a diffused fremitus, but loud and startling, as if issuing from the spot; in some cases cracked and jarring as in bronchophony; in others more articulate, and with a snuffling or hollow sound, as in pectoriloquy. These however are also the signs of tubercles and excavations in consumption, with which the lesion under consideration is commonly confounded; we must therefore seek for other distinctions. Besides in the history of the case, and in the character of the constitution, these are sometimes to be found,—in the situation of the sounds, which in phthisis is usually in the upper parts, but in dilated bronchi in the middle regions of the chest; in their character in relation to time, those in phthisis tending to increase and spread as the excavations proceed, whilst those of dilated tubes will remain nearly stationary for weeks and months; in there being less change in the shape of the chest with dilated bronchi than with phthisis, unless they have succeeded to pleuro-pneumonia, in which case the change is different; and, finally, in the nature of the sound on percussion, which in phthisis is more dull

chiefly under the clavicles, whereas in dilated tubes, if any dulness exist, it is generally in the mammary, lateral, or scapular regions of the chest, and is often accompanied by a peculiar hollow sound, which, from its resemblance to that produced by mediate percussion on the trachea, or by tapping with the finger on the mouth of a phial, we have called *tracheal* or *amphoric*. We shall have occasion to mention this sign in treating of pleurisy and pneumonia. The differential diagnosis between dilated bronchi and phthisical cavities will be better understood when the signs and symptoms of the latter have been fully described. We shall only add here, that when a case presents itself in which there have been cough, long continued with expectoration, dyspnœa, loss of flesh and strength, hectic fever, and even some of the physical signs of cavities in the lungs, the practitioner should be cautious in pronouncing it to be tubercular, if it be qualified by all or most of the following conditions: — If no proofs of a scrofulous habit can be traced; if the complaint have originated in a long-continued and violent cough, or in an attack of pleuro-pneumonia, and, considering its duration, emaciation have not proceeded far; if the purulent expectoration have been fetid and sanious, rather than flocculent or caseous; if the bronchial or cavernous respiration, or voice, be heard rather in the middle than in the upper portions of the chest, and be there spread over a considerable extent of surface; if these middle portions chiefly sound differently on percussion, being dull when the rest of that side sounds pretty well, or amphoric when the side is generally dull and contracted; and if, although the cough and expectoration continue undiminished, these signs remain stationary for many weeks together. In such a case the strong probability is in favour of its being one of dilated bronchi, and not phthisis.

It is obvious that dilatations of the bronchi, when once formed, can be little under the influence of medicine. The profuseness of the secretion may sometimes be restrained by acid mixtures; and we have known the nitro-muriatic acid in a few instances for a time remove its fœtor. Probably inhalations of chlorine or iodine would be useful in such cases. Where the cough is violent and troublesome, it should be allayed as much as possible by sedatives, such as hyosciamus, belladonna, conium, and particularly opium or some of the preparations of morphia; due attention being at the same time paid to the state of the excreting functions and the general condition of the system, which may need various kinds of treatment in different cases. The co-existence of chronic bronchitis often renders external counter-irritation of service, and other antiphlogistic measures are occasionally required for supervening acute inflammation. It is, however, from preventive measures that we may expect more success; and our knowledge of the causes and tendencies of this lesion suggests the inexpediency of abandoning the treatment of cases of bronchitis, pertussis, and pleuro-pneumonia, until the cough and physical signs have been satisfactorily removed. Most of the severe cases of dilated bronchi that have fallen under our observation, we have traced to imperfect treatment in former inflammatory attacks, especially those affecting the parenchyma of the lungs, which have yet been disguised under the name of a severe cold or influenza.

Ulcerations, Tumours, &c. of the Air-Tubes.

Ulcers seldom originate in the bronchi, but in connexion with some cause which concentrates inflammation in a peculiar manner on the bronchial membrane, and carries it to the submucous tissues, such as the habitual inhalation of irritating particles of dust, in the occupations of needle-pointers, stone-masons, and leather-dressers, the continued passage of tuberculous matter in phthisis, and occasionally the specific influence of measles, scarlatina, small-pox, and syphilis. We can describe no signs by which the presence of ulcers in the bronchi can be distinguished: but they rarely, if ever, exist without similar lesions in the larynx, in which case the voice is often impaired or lost. Ulcerations of the trachea and larynx are very common in phthisis, and, from the

observation of Louis, seem to be in some degree caused by the contact of the matter expectorated, for he found them particularly on that side of the windpipe on which the lung was most excavated. Ulcers of the larynx are commonly the effect of chronic laryngitis, which has already been described.

Tumours of various kinds are occasionally developed in the windpipe, and others external to the tube may press upon it and interfere with its function. The most common seat of the former is in the larynx: if small, they may continue long accompanied with violent cough and fits of stridulous breathing from spasm like chronic laryngitis: if large or of rapid growth, they may speedily occasion suffocation, preceded by the symptoms common to irritation and obstruction of the larynx.

External tumours pressing on the air-tubes are not of very uncommon occurrence. Of those situated in the neck, bronchocele sometimes has this effect; but, as Dr. Stokes has observed, it is chiefly by tumours originating within the chest, where the wind-pipe is surrounded by an unyielding frame of bone, that compression of this tube is produced. Such are aneurisms of the aorta and innominata, various tumours of the deep-seated cervical and bronchial glands, and enlargement of the thymous gland. We have met with instances of all these lesions, except the last, inducing pressure on the wind-pipe or one of its branches, and inducing dyspnœa, which in some cases was the obvious cause of death. In two cases the tumour was encephaloid, originating apparently in the bronchial glands, and surrounding the trachea at its bifurcation, both of the branches in one instance, and one in the other, being considerably compressed by it. In one of these cases the blood-vessels, although passing through the tumour, appeared to be quite free; in the other, the vena innominata was partially compressed. In a case of aneurism of the ascending aorta the right bronchus was compressed. In another of aneurism of the innominata the trachea was compressed at its bifurcation.

The signs of aneurisms compressing the air-tubes have been particularly described by Dr. Stokes. The general symptoms are dyspnœa, generally accompanied by acute bronchial irritation and a sense of constriction under the sternum, occasionally dysphagia, distension of the jugular vein chiefly on one side, œdema of the face, and other signs of venous compressions. The chief physical signs are hissing or sonorous respiration heard best at the top or on one side of the sternum, with weak vesicular sound on that side, various signs of displacement of the wind-pipe, the lung, and the clavicle, dulness on percussion, and occasionally projection of some of the upper portions of the chest, generally most on one side, in which in cases of aneurism, and sometimes of other tumours, there is a double or single pulsation. This is not the place for entering into details with regard to the signs of substernal aneurism; but we may remark that in more than one case we have observed slight oppression of the breathing at a very early stage, before there were signs of bronchial compression; and we are disposed to attribute this, as well as the paroxysmal attacks of dyspnœa occasionally occurring in the further progress of aneurismal and other tumours in this region, to an irritation, of the vagus and its recurrent branch, which these tumours generally affect; and we agree with Dr. Stokes that the alterations of the voice are referable to varying irritation of the recurrent nerve. But the laryngeal constriction is sometimes also complicated with inflammation, to which the air-tubes are particularly subject under the influence of aneurismal irritation. We lately witnessed a case in which a patient with a substernal aneurism was at the point of death from spasm of the glottis with stridulous breathing, which afterwards assumed the form of acute laryngitis, and was relieved by free expectoration after venesection and the prompt administration of mercury. In two instances we have observed dyspnœa, or rather oppressed breathing, for a time in connexion with scrofulous enlargement of the lymphatic glands, manifest in those of the neck and axilla, and supposed to reach to the chest, yet without the hissing breathing in the trachea or the de-

ficiency of vesicular sound in the lung, indicative of bronchial compression: the symptom here was probably from irritation of the pneumo-gastric nerve.

The treatment of tumours affecting the air-tubes is to be conducted on the general principles of counteracting as far as possible the irritation which they produce in the vessels, nerves, and muscles of the respiratory organs. Hence, according to symptoms, antiphlogistics, sedatives, and antispasmodics may be useful. Except in the case of enlarged lymphatic glands, it is of little use to attempt the cure of the disease itself. In that case a judicious course of alkalies and hydriodate of potash, with some mild tonic and sea air, will sometimes succeed in reducing the swellings, and removing the symptoms which they occasion.

PLEURISY.

Definition. — Pathological history, symptoms, and signs of acute pleurisy. — Symptoms and signs of the decline of acute pleurisy. — Chronic Pleurisy. — General symptoms. — Pathology. — Signs of absorption of the effusion. — Empyema — its symptoms, signs, and modes of termination. — Causes of pleurisy. — Diagnosis. — Prognosis. — Treatment of acute and chronic pleurisy, and of empyema.

Pleurisy, pleuritis, πλευρῖτις (*Hippocrates*), are names applied to inflammation of the pleura, the serous membrane covering the lungs and lining the thoracic cavity. The leading characters of this disease are, sharp pain of the side, dry cough, dyspnœa, fever, diminished resonance of the side, with ægophony followed by enlargement of the affected side and abolition of all sound of respiration and voice. But there is so great an uncertainty in the general symptoms, and variety in the physical signs, that a satisfactory knowledge of the disease can be obtained only through a study of its pathology: a short account of this will therefore simplify the history of the disease, and render more intelligible and available the description of its symptoms and signs.

Pathological history of Acute Pleurisy. The first known stage of inflammation of a serous membrane is an enlargement of the vessels in the subserous cellular texture: it is these chiefly that form the striated patches or points of redness that are seen after death in the earliest stage of pleurisy, and their distension can be felt through the serous membrane, which seems slightly uneven on passing the finger over it. Perhaps at this period there is a diminution of the serous exhalation at the inflamed spot, as we know such to be the first effect of inflammation of mucous membranes, and probably increases the friction between the surfaces. Soon, however, the flow of serum is increased, and with it, if the inflammation continue, an albuminous matter (coagulable lymph) is exuded. This exemplifies the most simple form of inflammation. The vessels have no compound structure or secretion to complicate or modify their action; and we find their increased development attended by an exaggeration of those secreting functions which they fulfil in health. These functions are two-fold, viz. that of liquid exhalation and that of solid nutrition: the fluid exhaled is serum; the material of nutrition is the albuminous or fibrinous part of the blood. In their natural proportion these functions preserve the membrane in a healthy state, one merely lubricating its surface with a slightly albuminous fluid, the other nourishing and sustaining the solid matter of the membrane. But when these functions are increased in activity by acute inflammation, there is an overflow of their products, the liquid effusion is more or less rapid and copious, and the excess of the nutritive secretion now appears on the exterior of the membrane in various forms, and, either by itself or mingled with the liquid effusion, consti-

tutes all the different products which are recognised as the results of inflammatory action. In its smallest proportion it is held in solution by the effused fluid, which on being drawn from the body, or after death, gelatinises from this fibrinous matter which it contains: where very abundant, it forms films or layers of lymph on the surface of the membrane; and this lymph is generally more abundant and disposed to speedy organisation, when the inflammatory orgasm is strong, and the blood rich in nutrient matter.

Following still the pathological history of pleurisy, we find in the lymph the product of adhesions; but whether or not these adhesions take place, depends on the quantity of liquid effusion between the pleuræ. This effusion to a certain degree gravitates to the lowest parts of the chest, and in those parts tends to keep the membranes separate; and if the upper parts of the pleura be inflamed, they adhere the more readily, unless the liquid effusion be very abundant. But if the pleuræ be inflamed only in their lower portions, a moderate quantity of liquid is sufficient to keep them separate; and if the lymph then become organised, it forms not an adhesion but a false membrane coating the lung, which may have further effects in modifying the remains or the products of the previous inflammation. Before we consider these various results of the modifying influences of time, of the degree and kind of inflammation, and of previous disease, on the pathological history of pleuritic cases, we shall take a view of the symptoms and signs of acute pleurisy.

Symptoms. These have been long considered as well marked by the sharp cutting pain in the side, restraining every common inspiration, and often making the act of coughing or deep breathing almost intolerable; the short breath which consequently results, the short dry cough, the general inflammatory fever, which with its antecedent rigor sometimes precedes the pain, but more commonly is developed with or after it, with hard quick pulse, heat of skin, flushed cheeks, and scanty high-coloured urine.

But it is now well-known that there may exist extensive pleurisy and its consequences without this array of symptoms; nothing is more variable than the degree and combination in which they may occur. Pain of some kind is most frequently present; it is generally acute, circumscribed, and referred to below the breast or lower margin of the pectoral muscle; but sometimes it is lower down or shooting, or more diffused and less severe, and not seldom there is very little or no pain at all, but rather some soreness or tenderness on pressure between the lower ribs of the affected side. When the pleura covering the diaphragm is inflamed, the pain is generally acute, referred to the margin of the ribs, and causes an unusual degree of distress and dyspnœa. This form of pleurisy is by no means commonly accompanied, as formerly supposed, by the *risus sardonicus* or delirium. The acute pain seldom lasts more than the first day or two, after which it may abate or entirely cease, although the inflammation continues, and the dyspnœa may increase with the accumulating effusion. The same remark is in some degree applicable to the fever, which is generally diminished in four or five days, assuming then a less inflammatory type. Sometimes it is very moderate, or of a remittent character; and this often happens when the effusion is most abundant. The degree of dyspnœa also varies much, being chiefly determined, first by the amount of pain, nervous sensibility, or catarrhal complication, and afterwards by the rapidity rather than the mere quantity of the effusion. The cough is a very uncertain symptom, being in some instances most distressing, in others altogether absent. In fact, so uncertain are all the general symptoms, that there are cases of what is called *latent* pleurisy, in which there may be scarcely a suspicion of the presence of disease in the chest, when pleuritic inflammation and its concomitant copious effusion have existed for many days or weeks. This is especially apt to occur in the course of fevers, or during convalescence from them, and in persons of weak or injured constitution; but it is occasionally met with in the healthy and robust.

The above-described symptoms may present themselves without pleurisy.

Sharp pains of a nervous character not unfrequently closely imitate that of pleurisy, especially in hysterical females; and if they happen to be attended with feverish excitement, the resemblance is more complete. In fact, the greater number of symptoms commonly supposed to be distinctive of pleurisy, depend on a morbid sensibility of the pleura, which is by no means a necessary accompaniment of its inflammation; and the symptom of oppressed breathing, proceeding from the pressure of the effusion, may be marked only when this effusion has accumulated very rapidly, or when the other lung has been prevented by prior disease from supplementary exertion.

Physical signs. On the other hand, the physical signs in the greater number of cases are very unequivocal, and although they by no means mark the degree or the intensity of the inflammation, they seldom fail to announce its presence, and they pretty accurately measure its most serious concomitant, the liquid effusion. We shall first enumerate these signs in the order in which they commonly occur, and afterwards consider the nature and value of each: —

1. Diminished motion and sound of respiration from pain; 2. Sound of friction accompanying the motions of respiration; 3. Dulness on percussion in the most dependent parts of the chest from the effusion; 4. Diminished motion and sound of respiration from the same cause; 5. Ægophony; 6. Cessation of vocal vibration felt by the hand; 7. Cessation of ægophony and all sound of the voice; 8. Enlargement of the side; 9. Displacement of the heart, liver, mediastinum, and intercostal spaces; 10. Increased motions and sound of respiration on the sound side.

1. The respiratory movements are so far within the control of the will, that they are instinctively restrained in parts affected with pain; and it is obvious that the sound of respiration will be diminished in proportion. This has been noticed by M. Andral as an early sign of pleurisy; but it is evidently a very equivocal one, since it depends on the presence of pain, which is not constant, and which may exist quite independently of inflammation

2. At the first onset of pleurisy a rubbing or creaking sound accompanying the movements of the chest is sometimes heard. This may be owing to a slight roughness or defective lubrication of the pulmonary and costal pleuræ at certain points, and, when combined with the general symptoms, may be considered a pretty exact sign; but it is very transient, and is seldom heard. It may be produced also by interlobular emphysema, in which case it lasts much longer. We are disposed to think that this sound is rarely produced by pleurisy, unless the lung be at the same time pressed against the chest by a tumour or by effusion, or partially distended by emphysema, or tuberculous or other deposits. The friction sound is commonly heard about the middle parts of the chest; it generally ceases as soon as the sound of percussion becomes more extensively dull: but in dry pleurisy, and in the cases of partial pressure before mentioned, it may continue for a long time.

3. In by far the greater number of cases of pleurisy there is an effusion of serum, soon after the commencement of the inflammation; and the accumulation of this liquid in the chest is the cause of the signs by which pleurisy can be best distinguished. This fluid will accumulate first in the lowest parts of the chest, floating to a certain degree the lung upon it. Hence these parts will sound more or less dull on percussion, whilst the higher parts retain their usual resonance: change of posture, by changing the place of the liquid, will in some degree alter the situation of these sounds. As, however, the external vesicular structure yields more readily to pressure than the tubular parts within, the accumulating fluid soon mounts up in the form of a thin layer, between the lung and the ribs, to a considerable height in the chest. This thin layer slightly impairs the sound on percussion, and this more distinctly if the percussion be gentle and abrupt, as by filliping on a finger tightly applied, and comparing the sound with that of corresponding parts of the opposite side. This sign, as well as those to be next described, is liable to modifications from adhesions previously existing between the pulmonary and costal pleuræ: these we shall

notice afterwards. As the effusion increases, the dulness becomes more complete and general, the infraclavian and scapular regions being generally the last to exhibit it. It often happens, however, that when even these are dull, there is some resonance in the axilla, transmitted through the fluid from the opposite lung. Sometimes, at a particular stage of the effusion, a tracheal or tubular sound is for a day or two heard on percussion below the clavicles and in the axilla, arising from the larger tubes which are not yet compressed.

4. The same accumulation of liquid must diminish the extent of the motions of respiration in proportion to its bulk, which has taken the place of the most expansible part of the lung. The sound of respiration will for the same reason be weakened, and its duration shortened in the affected side.

5. About the same time at which the dulness on percussion and diminution of the respiratory murmur reach the middle regions of the chest, there is a remarkable modification of the vocal resonance. It is heard much more distinctly than is usual in those regions; and it is superficial, as if produced in the spot, separately from the oral voice, and changed to a small bleating trembling note, which so much resembles the voice of a goat, that Laennec has well-termed it ægophony (*αἴξ*, a goat, and *φωνὴ*, voice). This modification of the voice is heard most distinctly in the space between the third and sixth ribs, which corresponds to the middle-sized bronchial tubes: but near the spine it is generally mixed with a louder and more uniform resonance, which is common bronchophony, from the larger tubes at the root of the lung. Two circumstances are remarkable in ægophony: first, that the voice is more audible at the very spot where the lung is pushed away by the liquid, in consequence of the liquid by compressing the porous tissue of the lung enabling it to transmit better the sound of the voice from its interior. The second point is, that the voice is altered in character: this may be supposed to be caused by the nature of the matter which it has to pass through, a thin layer of liquid, which, being thrown by it into irregular vibrations, trembles and dances, now checking the sound, now transmitting it with increased force, so that the voice comes through tremulous and wiry. The high tones of the voice are best transmitted in this way, for the bass tones do not enter the small tubes, but if strong pervade the whole tissue with a diffused fremitus. Hence ægophony is best heard in women, children, and others, who have high voices. In persons with a bass voice it is more commonly limited to the lower angle of the scapula or near the spine, and from being seated in larger tubes takes more the character of buzzing bronchophony. As the liquid increases, the ægophony becomes weaker, more distinct, and loses much of its flutter or tremor, having rather the sound of a very slender deep-seated voice, or a silvery echo of the original. This is owing to the lung being pushed so far away from the walls of the chest, and its tubes so much compressed; and as these conditions increase, the sound ceases altogether. It is not easy to determine what quantity of the effusion is enough to do this; but we are inclined to think that much sound of the voice is not transmitted when the layer of serum exceeds an inch in thickness, except over large tubes. If the ægophony remain stationary for several days, it is a proof that the effusion is moderate, and does not increase rapidly, which is a favourable sign: but it is often very transient, and many cases of pleuritic effusion are discovered after they have passed the degree which causes ægophony. Old adhesions will however modify this, as well as the other physical signs. When ægophony is most distinct, it is often coupled with bronchial respiration, especially between the scapulæ, where also there is a good deal of common bronchophony mixed with it. M. Reynaud has lately confirmed the original opinion of Laennec, that ægophony is a kind of bronchial voice modified by its transmission through a layer of liquid. He observed in a pleuritic case, that the ægophony heard at the lower angle of the scapula when the patient was sitting, became changed to simple or louder bronchophony when the patient stooped much forward or lay prostrate, this change of posture permitting the

liquid to gravitate to the anterior part of the chest, and floating the lung into contact with the parietes. Ægophony and bronchophony are different enough when their characters are well marked; but they often present mixed and doubtful varieties, that do not admit of such easy distinction. As far as description will go, we would represent the true character of ægophony to be a certain tremulousness in the voice when it is superficial, and an echo-like slenderness when it is deep-seated; whilst bronchophony may present many other varieties.

6. An early and very characteristic effect of the accumulation of liquid in the pleural sac, is its intercepting the diffused vibration of the voice, which is usually felt by the hand applied to the chest. A layer of liquid muffles and destroys this vibration; and it may do this even when ægophony is audible at the same spot, the vibrations of the latter being too fine to be felt by the hand. This affords a distinction between a liquid effusion and a consolidation of the lung, for the latter transmits the vocal vibrations with unusual force from the tubes. This diagnostic sign we owe to M. Reynaud; and it is the more valuable because it is easily obtained, even by a person who does not practise auscultation. It must not, however, be always considered as quite conclusive, for there are some exceptions to it, both positive and negative. For example, in case of partial adhesions of the lung to the chest, even more vibration than usual may be felt at the adhering parts, where the lung and its tubes are pressed into close contact with the walls of the chest: it may happen, on the other hand, in consolidation of the lung, that liquid or other obstruction in the bronchial tubes may prevent the voice from being transmitted through them.

7. As the liquid effusion increases, the ægophony and all sound of the voice cease throughout the affected side, except within two or three inches of the spine, and in spots where the lung may have been adherent, which frequently happens at the upper parts of the chest. The sound of respiration is also abolished in most parts, but never in the interscapular region, and rarely under the clavicle and in the axilla: it is, however, much weaker in these parts than on the sound side, and may probably be only transmitted from that side.

8. Enlargement of the affected side is another sign to be noticed. The effusion must be pretty copious to render this enlargement perceptible; but a difference between the two sides of the chest may sometimes be seen on inspection of the chest in different periods of respiration when the quantity of liquid is not very great. The affected side is first seen to be larger at the end of expiration, when it does not diminish equally with the other side, especially at its lower portions. So, on encircling the chest with a piece of tape, fixing it at the sternum and at the spine, it will be observed to tighten and slacken with inspiration and expiration more obviously on the sound than on the diseased side, which remains more fixed in a state of partial distension. As the effusion increases, the difference is perceptible through the whole respiratory act, and the eye can easily detect the want of symmetry, whether the inspection be made in front, behind, or from above, looking down on the patient's shoulders. To be more exact, however, the chest should be measured with a tape or riband passed horizontally around the chest, and made to meet at the centre of the lower end of the sternum; then taking it off by the point where it crosses the spinous processes of the vertebral column, the length of the two sides may be compared. In making this comparison it must be recollected, that the right side in the healthy state is from a quarter to half an inch larger than the left. Laennec remarked that the enlargement of the side is sometimes discoverable, by the eye as well as by measurement, two or three days after the first attack of pleurisy: but it does not generally proceed afterwards in proportion to the effusion until this becomes excessive, and has displaced the adjoining parts to a great extent.

9. A very important class of signs arises from the displacement of certain of

the walls and organs bounding the effusion. Laennec remarked that the intercostal spaces on the affected side do not present their usual depressions, and are sometimes, especially in chronic cases, even prominent beyond the surface of the ribs. This had been noticed by surgical writers in empyema. It is scarcely perceptible, however, in acute pleurisy, unless the subject be thin. In such cases we have seen the intercostal spaces not only prominent, but presenting also an evident fluctuation. In looking for this sign, the patient should be placed obliquely with regard to the light; and it may be more readily seen by surveying the chest from a little distance, than by a closer inspection.

But we may generally learn more from the displacement of the organs adjoining the effusion, especially the heart and the liver. Laennec barely noticed these displacements. To Drs. Stokes and Townsend we chiefly owe their application to the diagnosis of liquid effusions in the chest. The displacement of the heart by an effusion in the left pleura, is the most valuable and easily recognised of these. In this case the pulsations of the heart are felt and heard most distinctly under or to the right of the sternum, or in the epigastrium, instead of, as usual, between the cartilages of the fourth and sixth left ribs. On the other hand, a very abundant effusion on the right side will push the heart so far to the left, that it may be felt beating below the left axilla. But in this case the more remarkable displacement is that of the liver, which by feeling and percussion will often be found far below the margin of the ribs. Sometimes it forms a distinct tumour in the abdomen; and we have known more than one case of latent pleurisy, in which this tumour was long supposed to be the chief disease, the patient not complaining at all of the chest. Dr. Stokes has published some interesting observations with the view to prove that the displacement of the diaphragm and intercostal muscles in great measure depends on paralysis of their muscular fibres, the result of the inflammation of the pleura which covers them. The displacement of the mediastinum is to be discovered only by percussion; situated as this is naturally in the mesial plane, it divides the two cavities of the pleura at a line down the middle of the sternum, which bone sounds well on percussion from the margins of both lungs which lie under it. But a copious effusion will push the mediastinum towards the opposite side, and, by occupying the whole space behind the sternum, will give this bone a dull sound on percussion, and this may even extend half an inch or an inch beyond it. All these displacements may also be produced by an accumulation of air in the pleural sac, but the tympanitic sound on percussion would at once distinguish this case.

10 In all cases of physical examination, the two sides must be examined with a view to comparison; and in case of pleuritic effusion it will be found, that the sound side will give not only the negative proofs of the absence of disease in it, which may well be compared with the positive signs of disease on the opposite side, but it will even show an exaggeration of the signs of healthy action, in consequence of its work being really increased. Thus, whilst the diseased side is almost fixed, the healthy side will be seen to move more fully and quickly than usual, and the sound of respiration will be increased in a remarkable degree, so as to resemble the loud respiration of children; hence it is called *puerile.*

We have before noticed that the physical signs of pleurisy are liable to be much modified by old adhesions, which bind the lung to the walls of the chest. When the adhesions are loose, they only form bands or cells distended with fluid; and, keeping the lung at a moderate distance from the walls of the chest, they may render the continuance of ægophony much longer than it would be without them. When an adhesion is so close and strong that the accumulating fluid cannot separate it, the lung is there compressed against it; or if there are several adhering points, the attachments to these are preserved by so many pillars of compressed lung at these adhering parts: if they be at the upper or middle regions of the chest, instead of a total abolition of the voice and respiration, there may be loud bronchophony and bronchial respiration, transmitted

from the large tubes by the adhering dense column of lung. Sometimes the adhesion is to the diaphragm or mediastinum; and it may then prevent or modify the displacement of these parts by the fluid. Not uncommonly the adhesions are more extensive and close, especially to the upper parts of the chest, and then the lung is pressed by the effusion from below against the whole of the upper walls of the chest. In this condition it may still admit air, and be quite resonant on percussion; but as much of its vesicular structure is compressed, the sound of respiration there will be tubular or bronchial, and a noisy bronchophony will be transmitted by it to the whole upper region of that side. We have often heard the voice and respiration quite tracheal from this cause. The displacement of the heart and liver, the prominence of the intercostal spaces, and the dulness on percussion of the whole lower portion of the sternum, together with the immobility and enlargement of the lower part of the affected side, will generally distinguish the true nature of these cases. Much more rarely the lung adheres closely to the whole of the lower part of the chest, and the effusion occupies the upper. In such cases there may be pulmonary resonance in the lower parts, with obscure sound of respiration. The upper may be dull in the situation of the effusion; but sometimes, from the top of the sternum to the middle of the clavicle and below it, there is a remarkable amphoric or tracheal resonance, with some respiration of the same character, yielded by the large tubes through the effused fluid. The character and production of this sound may be illustrated by filliping on a finger pressed against the trachea when the mouth is open. The windpipe passes under the sternum, and divides into the two great bronchi, which spread between one and two inches below the clavicles. Here in health the porous lung lies over these tubes, and intercepts their resonance on percussion; but if this be perfectly condensed by liquid effusion, or perfectly consolidated by hepatisation, the hollow note of the tubes will be produced on percussion, just as it is over the windpipe, where no lung intervenes.

Symptoms and signs of the decline of Acute Pleurisy. The general symptoms seldom maintain their acute character for many days. The stitch in the side ceases, or is felt only in a long breath, or in coughing; sometimes, but not always, accompanied with soreness. The cough, if there be any, generally continues, and becomes bronchitic. The pulse sometimes loses its hardness, and is reduced in frequency; in other cases, particularly when the effusion is very copious, it remains as quick as ever, although it may be weaker. The difficulty of breathing is perhaps less apparent, but the frequency is often not diminished, whilst the effusion is unabated, although the patient is scarcely sensible of it. In other cases again, in the course of a few days, the breathing returns nearly to the natural state, although one side of the chest is full of fluid. In almost all cases, lying on the healthy side embarrasses the breathing, both by restraining its movements and by causing the fluid to press against the heart and the sound lung. For the same reason, pressure on the abdomen may cause little uneasiness on the diseased side; but on the sound side, by impeding the descent of the diaphragm, it produces a feeling of dyspnœa, even when none may be otherwise present. Not uncommonly after the few first days of the disease, when the acute symptoms have in great measure subsided, the patient complains of nothing but weakness, and calls loudly for an improved diet. It is especially in such cases that we must be in great degree guided by the physical signs: if these indicate that the effusion is undiminished, or even increasing, we may be sure that the inflammation is not subdued, but only latent. But if, from an improved resonance on percussion, and returning movement and sound of respiration, first in the upper parts of the chest, as well as a diminution in the volume of the affected side, we find that the liquid effusion is on the decrease, we may judge that the inflammation is subdued, and that its products will gradually be removed. The reabsorption of the fluid sometimes takes place in the course of two or three weeks; and in that case ægophony returns when the layer of fluid is thin

enough to permit the vocal resonance to pass through it, but more commonly the fluid is not dispersed for a much longer time. Laennec remarks that an effusion which has been formed in the course of a few days is sometimes not entirely removed at the end of six months; and we can add our testimony to the truth of this observation. In such cases the return of ægophony is very uncertain: in fact the signs are rarely watched during so long a period, and the patient may cease to be the subject of medical treatment before the effusion is sufficiently reduced to give transmission to the voice. In very moderate cases the liquid is absorbed before the lymph or albuminous matter is removed; and when the pleural surfaces covered with this come together, a sound of rustling or rubbing is sometimes heard with the movements of respiration; but this soon ceases, as the lymph is converted into adherent bands of false membrane. Now if these false membranes are formed after the liquid has been removed, and the lung has recovered its full extent of expansibility, they are adapted to its free motions, and do not to any material extent interfere with them. Hence in dead bodies we often find adhesions which are lengthened in the lower parts of the chest, where, from the action of the diaphragm, the lungs descend as the ribs rise, whilst in the upper parts the adhesions are short, because the lungs there follow more exactly the movements of the walls of the chest.

But in more severe or obstinate cases, which are not uncommon, the inflammation continues after the liquid has been abundantly poured out, and not only increases and perpetuates this liquid effusion, but also throws out albuminous matter in various conditions, which by its present qualities, or future changes, may produce a variety of prejudicial effects, all tending more or less to interfere with the perfect restoration of the organs to a healthy state. These, and the signs and symptoms which they produce, may be better considered under the head of chronic pleurisy; for although inflammation in which they originate may often be acute at the first, yet the course and character of these changes are quite of a chronic description

Chronic Pleurisy.

General symptoms. There is less reason for distinguishing formally between acute and chronic inflammations of the pleura, because the transition of the one to the other is really not defined; and the symptoms of the recent disease sometimes have so little of an acute character, whilst that of a long duration occasionally manifests such an intensity of irritation, that the terms acute and chronic are less applicable to pleuritic affections than to inflammations of most other organs. We can see some reason for this in the fact, that the pleura, being a short sac, is liable to have its acute inflammation converted into chronic by the retention of its product; and chronic pleurisy is liable to be excited into an acute state by the distending or irritating influence of the effusion. Still differences are very apparent in many cases, in the prevalence of high inflammatory fever in some, and in there being no fever, or one of a hectic kind, in others; in the sthenic condition of the circulation in some, and its weak depressed state in others, whatever be the degree of pain or nervous irritation accompanying them. Thus it may happen that an acute inflammation with all its prominent symptoms has been apparently subdued; but the effusion remaining undiminished, the disease goes on in a latent form, until, from some imprudence on the part of the patient, who supposes himself cured, an attack of dyspnœa, or a stitch in the side, again lays him on his bed; and although these symptoms may generally be mitigated, they then leave those more peculiar to chronic disease. Of these a remittent or hectic fever, with permanently quick pulse; gradual emaciation; shortness of breath, particularly on exertion; inability to lie on the healthy side,— may be mentioned as the most common: occasionally there is cough, and there may be purulent expectoration from a concomitant chronic bronchitis, and various degrees of pain in the affected side; but these symptoms are very uncertain. A chronic form of pleurisy is sometimes developed gradually without being

preceded by a distinct acute attack; but it is probable that many of these cases are at first acute in a latent form, the patient having been supposed to suffer merely from a cold, or a slight feverish attack, during the acute stage of the disease, and the local symptoms not attracting attention until they have become more developed in the chronic form.

Pathology. In tracing the signs and complications of the more chronic forms of pleurisy, we shall be enabled to exhibit them more concisely and intelligibly through a rational view of their pathology, as we have studied it in the signs and anatomical effects.

Besides serum and coagulable lymph in their simplest forms, which may be speedily removed and organised, inflammation, particularly the more chronic kind, may generate the following products, which are less readily removed, and which tend more or less to interfere with the restoration of the organs to a healthy state.

1. Healthy and highly organisable lymph, when deposited in a thick layer, must in some degree restrain the expansion of the lung, and thereby retard the absorption of the fluid. This lymph may be diminished by absorption; and the membranes formed of it may ultimately adapt themselves to the full expansion of the lung; but there will be less chance of this in proportion as the liquid effused is copious, and its removal slow.

2. In cases similar to that just mentioned, but with a lymph less organisable, the product of a less active inflammation, or in which there is much of the colouring matter of the blood (but not in this case only, as Laennec supposed), its organisation is more tardy, and the membrane resulting is of a more rigid and less yielding nature; consequently the lung is more permanently confined in its compressed state. The membranes which are formed on the pleura in these cases are sometimes quite cartilaginous in density, and of considerable thickness; and occasionally they are found, in process of time, partially ossified. If these acquire their density before the liquid is removed, it is clear that they must for ever bind down the lung: but we have seen cases in which there have been signs of further contraction after the absorption of the liquid, which may be ascribed to the tendency which some newly-formed tissues have to contract for some time after their production. This is exemplified in the contraction of the cicatrices of burns of the skin, and of the false membranes lining cavities of the lung; and in other cases, where false membranes have been slowly formed, and tend to assume a fibrous or fibro-cartilaginous rather than a serous or cellular structure.

3. But the inflamed pleura may effuse lymph of still lower vitality, susceptible of but imperfect organisation, and wholly incapable of throwing out more of an organisable character: hence, when the pleura is coated with it, if the inflammation continue, the overflow of the nutritive secretion will be in the form of a curdy matter, or of mere loose shreds of solid albumen.

4. The solid matter may be thrown out in a disintegrated state, utterly insusceptible of organisation, and diffused through the fluid in flakes or particles forming a mixture more or less resembling pus, which is the fluid of empyema. Although in many instances this is the result of a more chronic form of pleurisy than that which forms lymph, and owes its persistence and tendency to increase to the want of vitality in its solid matter, yet we do meet with cases of empyema which arise from very acute forms of inflammation. In these instances the fluid is more strictly purulent, the solid matter being in the form of globules, like those of pus; and seems to be the result of what may be called a suppurating diathesis; in consequence of which, all the albuminous products of inflammation tend to assume a purulent character. In such a case we have seen pus within a fibrinous clot in the heart; and it is difficult to avoid the supposition that it is something in the condition of the blood that determines this less usual product from the acute inflammation of a serous membrane. It is well known that the continued access of air will cause the inflamed pleura, as well as other internal textures, to secrete pus instead of lymph; hence, when-

ever pleurisy is excited by the perforation of the lung, the liquid poured out is more or less purulent.

5. Lastly, as the solid accretions on the inflamed pleura, we may find the various morbid productions called tuberculous, scirrhous, encephaloid, and melanotic; these being commonly the result of some constitutional taint developed by the local inflammation; but in the case of the first and last, probably sometimes the product of peculiar modifications of the inflammation itself.

It is not to be supposed that the products of pleurisy in every case belong exclusively to one of the kinds now described, or that they are so simple as to be rigidly divisible by any such classification. We rarely examine a case of protracted pleurisy after death, without finding traces of several forms of the products of inflammation; and a comparison of many discovers that these pass by insensible gradations into one another; so that, although we may meet with some that are clearly referable to one class of products, there are others of a mixed or intermediate character. If we reflect on the consequences of all these products of prolonged inflammation of the pleura, we must perceive that they all tend to keep down the lung in the compressed state to which it was reduced by the first effusion; and they do this by the rigid false membranes which are formed when the solid effusion is susceptible of organisation; and by the persistence of the liquid effusion when the solid matter is destitute of organisation, and acts as an extraneous irritant. We must suppose, too, that the absorbing properties of the pleura must be altered by the long continuance of disease; and that various lesions are propagated to the adjoining tissues, which, however they may have escaped the immediate effects of inflammation in its acute form, can scarcely fail to be affected by the slow and less limited influence of chronic inflammation. Hence the parenchyma of the lung, the bronchi, the pericardium, the bones and cartilages of the chest, occasionally become the seat of various changes: thus, the lung becomes at first consolidated, and afterwards atrophied; the tubes secrete pus, and become dilated; the pericardium forms adhesions to the heart, and becomes thickened; and in cases of empyema, the ribs, vertebræ, and their cartilages, may become carious. Nor must we forget the unfavourable operation of the disease on other functions, the obstruction to the circulation by pressure on the pulmonary and adjoining vessels, the abridgment of the function of the lungs themselves, and the irritating or depressing influence occasionally extended from the seat of lesion to the various organs of the abdomen. In fact, besides the injury done to the respiratory organs, an imperfectly cured pleurisy may in an insidious manner oppress the whole system, and bring it into an anomalous cachectic state, in which morbid conditions of various kinds may be produced or brought into activity. Thus we have met with several instances in which tuberculous disease was first developed after pleuritic attacks, and in two instances we have found the tubercles confined to the uncompressed lung, indicating that their development was posterior to the compression of the other lung, in which their deposition was mechanically prevented.

For practical purposes it will be convenient to divide the preceding results of pleurisy into two classes:—1. Those in which absorption ultimately predominates over effusion, and the liquid is gradually removed; and 2. Those in which the effusion predominates, and the liquid can only be removed through a perforation of the pleura.

Signs of absorption of the effusion. In the first of these, as the absorption of the fluid proceeds, what is it that supplies its place? The lung, as we have seen, may be either so bound down by rigid false membranes, or so condensed and obliterated by long-continued pressure and inflammation, that it is not susceptible of its former expansion to effect this purpose. In the great majority of cases, as the liquid is absorbed, the walls of the chest are contracted or collapsed, so that the diseased side, which at the height of the effusion measured perhaps an inch or two more than the healthy side, now gradually becomes considerably smaller, sometimes to the extent of two or three inches.

The contraction is first perceptible in the upper part of the chest, and with the depression and more fixed condition of the shoulder contrasts remarkably, on inspection, with the full development and active motions of the sound side. On examining the contracted side more narrowly, we see, in detail, that the ribs are lower at the sides and closer together, the scapula more prominent and nearer to the spine; and sometimes the sternum, and occasionally even the spinal column also, are curved concave towards this side. In all this we see the results of the atmospheric pressure, together with unantagonised muscular efforts, acting on the walls of the chest. The same pressure tends to fill the cavity from the abdomen: thus the diaphragm is pressed permanently upwards, carrying with it the mass of the liver on the right side, and the resonant stomach on the left; and on watching the abdomen, it is not seen to swell on that side, as on the other, at each inspiration. In some cases, too, the same pressure is exerted within the chest from the sound side, causing displacements the very reverse of those which had been occasioned by the pressure of the previous effusion. We have seen many cases in which the healthy lung had displaced the mediastinum towards the contracted side, not only under the whole sternum, but even under the cartilages of the ribs to the extent of an inch beyond it; so that these parts sounded well on percussion, and the intercostal spaces there showed movements of respiration which scarcely affected any other part of that side. Dr. Stokes has recorded a case in which, after the absorption of an effusion on the right side, the heart was drawn over to that side, so that its pulsations were felt to the right and not to the left of the sternum. We have met with three examples of this kind, in which the heart became permanently displaced to the right. We have also seen, after the removal of pleuritic effusion on the left side, the heart drawn upwards to the left, so that its pulsations were distinct from the fifth to the third rib, near the axilla. Dr. Stokes describes a case in which, after an acute effusion on the left side, which displaced the heart to the right of the sternum after the removal of the effusion, the heart remained loose, falling from one side of the sternum to the other, according to the position of the body.

We proceed to describe the signs obtained by auscultation of a side contracting after chronic pleurisy. In many cases where the effusion has been copious and of long standing, the sounds of respiration and percussion continue permanently imperfect, although the liquid be completely removed; and in almost every case they are more or less impaired for months after the attack; in fact they correspond pretty well with the appearance and diminished motion of the affected side, and are to be referred to the same causes. The improvement is generally to be found first in the upper part of the chest, and near the spine. With the return of a weak respiratory murmur, and slight resonance on percussion, some degree of vocal resonance may also accompany the removal of the liquid in the upper parts of the chest, amounting to loud bronchophony, often accompanied by a remarkable *buzz*, in other parts being merely the diffused vocal fremitus, according to the size of the bronchial tubes and the degree and permanency of their compression. This is one of the instances in which some physical signs may deceive us, unless attention be paid to all, and to the general history of the case; for if, for the first time, we see a patient with the above signs, and he happen to have bronchitis, we may be led to believe that the resonance of the voice and the dulness are caused by consolidation from recent inflammation of the lung, or from tubercle: but this error may be avoided by attending to the history of the case, and the signs of contraction that characterise it. The dulness on percussion in the contracted chest is less owing to the absence of air, than to the compressed, drawn-in condition of the walls, which are no longer free to vibrate: and although there be air in considerable quantity in the lung underneath, this air gives no spring to counterbalance the atmospheric pressure, which is continually acting as a dead weight on the contracted side. Sometimes more sound may be obtained by pressing the fingers strongly on the side, and then striking on them; this pressure brings the walls

beyond the unequal atmospheric weight, so that they may then vibrate more freely, as we have formerly explained.

We find, then, that in these cases of pleurisy the condition of the side of the chest was, at the period of the copious effusion, the reverse of what it becomes when that effusion is removed; then it was dilated, and the adjoining parts pushed from it; now it is contracted, and the adjoining parts drawn into it. Is there not, then, an intermediate stage, in which neither of these conditions is presented, and the side has the usual shape and dimensions? Our experience leads to the conclusion that there is not; but that the transition from one condition to the other is not generally uniform, but partial. The common case is that the contraction begins in the upper part of the chest before the dilatations and displacements have ceased in the lower; and it seldom happens that there is not, during the diminution of a pleuritic effusion, an irregularity in the shape of the chest, a comparative bulging of the lower portion, which may serve to distinguish it from consolidation of the lung.

In the cases hitherto considered, the effusion has been supposed to be general and to fill the cavity of one side of the chest; and the contraction after its removal, although irregular, to be also general. In case of partial effusions limited by rigid adhesions to transverse portions of the chest, it is plain that the thoracic walls cannot contract enough in those parts to obliterate them. In the few cases of this kind which we have seen, there had been partial contraction; but the space occupied by the effusion was chiefly filled either with air, or by the adjoining viscera pushed in, or with a semi-solid curdy fluid, probably the inspissated remains of the effusion.

It might be supposed that individuals, whose lungs are reduced, by contraction of the chest after pleurisy, to little more than half their natural size, would be reduced to a very frail state of health and a low scale of bodily strength; yet it is curious enough, that some such individuals have continued to enjoy good health, and to be actively engaged in the pursuits of life. Laennec mentions the case of a distinguished surgeon of Paris, who, although he had one side contracted, in a very marked degree, from an attack of pleurisy in his youth, yet enjoyed excellent health, and was in the habit of lecturing twice a day without inconvenience. We have met with a few instances of the same kind, but they were in young subjects in whom the walls and organs of the chest are capable of more extensive adaptation than in after life, and in no such case have we found the contraction excessive, nor the respiratory murmur nearly abolished. In other cases (and they are, we believe, the most common) extensive contraction of the chest causes such an habitual shortness of breath and tendency to palpitation, as to incapacitate the subject from active exertion, so that even slight bronchial attacks, or febrile excitement, cause severe and distressing dyspnœa. We have further had occasion to observe, that before the system becomes accommodated to the abridgment of respiration which this lesion produces, and even afterwards, under unfavourable circumstances, there is an enfeebled or cachectic state of the whole frame, in which various trains of disorder may arise; and unless care be taken to counteract them by remedies and circumstances most favourable to the general health, scrofulous or dropsical disorders may be engendered, and develop new mischief in the respiratory organs or elsewhere. Although, therefore, we may look on contraction of the chest as a mode of curative termination of pleurisy, it is one of the least favourable kind, and liable to many detracting circumstances.

Empyema.

The other class of cases in which effusion preponderates over absorption, and the liquid can only be removed through a perforation of the pleura, comes next to be considered. This character is to be traced in some instances to the condition of the membrane, which, either from its continued inflammation, or from change of its structure, secretes more than it can absorb: sometimes the

accumulative tendency of the effusion may arise from some obstruction in the circulation, dependent on disease of the heart or great vessels, on tuberculous or other consolidation of the lungs, or even on the partial pressure of the effusion itself. But the more common cause of increasing effusion is in the nature of the matter effused, which when of a purulent character is not readily absorbed, and constitutes the *Empyema* of authors.

The symptoms and signs of empyema are generally those already described as indicating extensive liquid effusion, but they may be modified by the length of time that effusion continues: thus, although the feeling of dyspnœa, and perhaps the fever, may have abated, even with the effusion on the increase, yet the general disorder of the system, and the signs of enlargement of the side, and displacement of its usual boundaries, commonly become more marked. It is by no means constantly observed that the effusion of pus is peculiarly marked by the occurrence of rigors, hectic fever, or more constitutional disturbance than that which attends the effusion of mere serum and lymph; but when such symptoms do occur, there is a probability in favour of the effusion being truly purulent. The long-continued pressure, perhaps joined, as Dr. Stokes has suggested, with the paralysing influence of prolonged inflammation, causes the muscular portions of the walls to yield to an increased extent; hence the intercostal spaces become more prominent, the diaphragm further pressed into the abdomen, carrying with it the abdominal viscera. Thus on the right side the liver may be pressed down to the umbilicus and ilium, causing a protuberance there, which has not unfrequently been mistaken for the chief disease. On the left side, the stomach is not generally so much displaced, but the diaphragm is pushed down more behind, carrying with it the spleen and the colon, the pressure on which sometimes seems to cause flatulent distension of the abdomen. In a case of this kind which we have recently witnessed, the enlargement of the chest was entirely behind, the left infra-mammary region not being at all full, and giving the resonance of the stomach, although the heart was displaced to the right of the sternum.

When the effusion is purulent, there is not uncommonly associated with it an ulcerative process, which may permit the matter to escape through the lungs, the walls of the chest, or the diaphragm, and which, in cases of long continuance, often involves other parts besides that through which the matter is evacuated. Thus after death we often find small excavations in the layer of semi-organised lymph coating the walls of the chest, and in some instances this ulceration perforates the pleura and a layer of intercostal muscles, without proceeding further. In other cases the ribs, vertebræ, or sternum, become partially carious from the same cause. When this ulcerative process proceeds so far as to cause the matter to point externally, a soft fluctuating swelling is felt at some part of the chest; and it may generally be known to communicate with the interior of the chest by its becoming tense during expiration, and softer during inspiration. Not uncommonly the matter burrows under and between the muscles and integuments of the chest, and points at several places, and at a distance from the perforation of the pleura. We have seen abscesses connected with empyema point in three instances under the pectoral muscle, once in the right hypochondriac region, and once close to the spine: that in the hypochondriac region had been mistaken for an abscess of the liver; in this case it was found after death that there were perforations of both intercostal muscles and diaphragm; and between the layers of the latter, the matter passed to the margin of the ribs, and there spread under the integuments, communicating with the other perforation between the ribs. The superficial abscesses are sometimes accompanied by much local pain and tenderness; but in some cases these are scarcely complained of. These abscesses are generally slow in opening spontaneously: they generally first spread between the muscles and integuments, causing a puffy state of the parts. When the opening does take place, there is a discharge of matter, more or less copious; and this recurs from time to time, especially during any strong efforts of expiration, as in coughing. Sometimes

air is drawn at the orifice during strong inspirations, and the next jets of matter issue with greater force, occasionally mixed with bubbles of air. After the air has gained access to the empyema, the pus, which was at first inodorous, generally in a few days becomes fetid, exhaling the odour of sulphuretted hydrogen: and with this change in the discharge, there is increased constitutional disturbance, sometimes manifesting itself in form of irritative fever, with bounding pulse and heat of skin, alternated with colliquative sweats; sometimes producing typhoid symptoms, and a state of general depression.

When the matter of empyema is discharged by ulceration through the lungs or bronchi, there is a violent fit of coughing almost like vomiting, ending in the expectoration of large quantities of matter. These efforts sometimes threaten suffocation: but the discharge is followed by considerable abatement of the symptoms. Laennec considered this a more common event than perforation of the walls of the chest: our own experience would indicate the contrary; but there are on record many cases of both results. The ulceration through the substance of the lung or air-tubes is described by Dr. Townsend to be accompanied by the formation of a gangrenous eschar, which is detached, and the fistulous passage is lined with a false membrane, which prevents the matter from spreading through the lung, and conducts it to the air-tubes.

The evacuation of the matter by fistulous openings may go on continually, or recur from time to time, with more or less temporary relief, for weeks, months, or even years; the patient in some instances recovering, in others sinking from the continued effects of the disease. In the former case, the discharge soon becomes less, and entirely loses its fetid character; the wound heals, and the chest gradually becomes contracted in the manner before described, there being a partial return of respiration in some portions of the chest.

Causes of Pleurisy. We are not aware that any circumstances predispose to pleurisy further than those which render the body liable to other inflammations, such as a relaxed or debilitated state of the system after fevers or other severe disorders, the puerperal state, &c.

Of the *exciting* causes of pleurisy, cold is by far the most common, especially exposure to cold winds; hence it is observed to prevail especially in the month of March. It may, however, be excited by external injuries, such as wounds and contusions of the chest, fractured ribs, &c.: in these cases the disease is not uncommonly latent, and becomes chronic. It is an occasional complication of continued and exanthematous fevers, particularly in some epidemics, constituting one of their dangerous complications. Less frequently it is excited by gout or rheumatism; and on the sudden removal of a cutaneous eruption, or healing of an old ulcer or other habitual drain. It sometimes occurs from the extension of inflammation from the lung, the peritoneum, or the walls of the chest. From the latter cause, it not unfrequently forms the closing scene in cancer of the breast. It is occasionally associated with erysipelas, diffuse inflammation of the cellular tissue, inflammation of the veins, and puerperal fever: in such cases it is usually latent, and accompanied by the typhoid symptoms common in those formidable diseases. It is not uncommonly excited by tubercles in the lung, both in their solid state, and after they have been softened. In the latter case, when the pleura is perforated, there is generally, also, the admission of air into the pleura, producing the complex lesion, pleuritic pneumothorax, to be afterwards noticed.

Diagnosis. In its very earliest stage, at the first attack of pain, pleurisy may be mistaken for pleurodyne and nervous pains of the chest and upper part of the abdomen; and as there are rarely any distinctive physical signs at this period, we must seek for the character of pleurisy in the general symptoms of fever, heat of skin, and sharp hard pulse, and sometimes in the short dry cough which accompanies it. In a short time, however, the physical signs become the most characteristic marks of the disease. It is unnecessary here to repeat the description, and it only remains to point out the signs which distinguish pleurisy from some other lesions that most resemble it. Consolidation

of the lung differs from pleurisy in its not causing any displacement of the contents or walls of the thorax; and generally, also, in its increasing the vocal resonance of the affected side, whether heard, or felt by the hand; and by its leaving some sound of respiration which is generally of a bronchial character. Partial pleurisies confined by adhesions are less easily distinguished, because, where the lung is adherent, there may be as much bronchophony and respiration as in cases of consolidation; but on examination these will be found to be more circumscribed than in the latter case, all sound being absent in other parts, which further present the signs of enlargement or displacement of the heart, liver, or mediastinum, with fulness of the intercostal spaces, generally more remarkably than usual. A similar irregularity in the shape of the chest will serve to distinguish pleurisy in the progress of cure by contraction of the chest, from the case of a consolidated lung. The diagnosis of intrathoracic tumours will be described under their head.

Chronic pleurisy is liable to be confounded with tuberculous phthisis, for their general symptoms are often very similar; and in truth they sometimes coexist, or run into one another. But their physical signs sufficiently separate the two kinds of lesion; there never being in phthisis that general dulness and absence of respiration, with enlargement of the side and displacement of parts, which occur with empyema. The expectoration in chronic pleurisy is sometimes purulent without any communication with the pleura, or disease in the substance of the lung; it is in fact the product of a bronchitis which generally accompanies the last stages of most diseases of the chest. From simple bronchitis, dilated air-cells and tubes, and other chronic affections of the chest, the distinction of pleurisy through its physical signs is sufficiently evident. Its diagnosis from hydrothorax will be afterwards pointed out.

Prognosis. Simple acute pleurisy, although a serious disease, and full of danger when neglected, generally yields to remedies promptly employed before the effusion is copious. But if active measures have been delayed or insufficiently used, or if the effusion be purulent, or if there be other diseases in the chest, such as organic lesions of the heart, liver, or kidneys, or tuberculous or other deposits in the lungs, pleurisy often becomes an intractable and even fatal disease. It does not commonly prove fatal in its acute stage from the quantity of the effusion, except when the disease attacks both pleuræ at once, or in cases in which empyema, or some previously existing disease in the other lung, prevents its free expansion to supply the defect of that which is compressed. The very rapid accumulation of the effused fluid is generally an unfavourable sign; for experience has proved that in such a case its dispersion is more difficult. When the acute symptoms have subsided, and the extreme oppression resulting from the first effusion has abated, the probable issue of the case will depend much on the condition of the general health and strength. If this continue pretty good, there is reason to hope that the effusion will be gradually removed; and this hope becomes more sure as soon as the sounds of percussion and respiration are heard returning to any part, however small, in which they had been previously absent. But if the weakness of the body increase, and some of the functions be more or less disordered, the urine scanty and high-coloured, the legs or surface œdematous, or the expectoration purulent, with night sweats and increasing emaciation, there is much reason to fear an unfavourable issue, either from the nature of the effusion or the want of power to effect its absorption before it fatally oppresses the vital functions. In case of empyema, where the purulent matter makes its way into the bronchi, or through the walls of the chest, although its discharge may give considerable relief for the time, yet the improvement may be but temporary; and here also the ultimate result will much depend on the general health and strength, as indicated by the rational symptoms, as well as on the condition of the lungs and other organs. Where these circumstances are favourable, a permanent cure may follow; or the spontaneous discharge continuing to a greater or smaller

extent, a tolerable share of health may continue for months and even years. But not uncommonly, before the matter finds its way externally, it has produced serious mischief in other parts, and by totally destroying the irritability of the intercostal muscles, by causing caries of the ribs, sternum, or spine, extensive fistulous abscesses in the walls of the chest and abdomen, or tuberculous deposits in the lungs, and at the same time injuring the constitution generally, it leaves the body in a condition most unfavourable to the restoration of health. These circumstances suggest the propriety of anticipating the process of nature, by artificially evacuating the matter before these serious consequences ensue.

Treatment. The leading indications in the treatment of pleurisy are, 1. To subdue the inflammation; 2. To promote the removal of its more injurious products; 3. In chronic cases to improve the state of the general health, and to counteract the injurious effects of the persisting disease.

The most desirable object is to destroy the inflammation at its very onset, before the signs show that the effusion is considerable. For this purpose, the most effectual remedy in severe cases is a full general bleeding, carried, if possible, to such an amount as to remove all pain on full inspiration; or, if there be little or no pain, until all hardness of the pulse ceases. This should be followed by free leeching or cupping of the affected side. We think leeches generally preferable; but they should not be applied sparingly, and they should be immediately followed by a large warm poultice covered with flannel, or by a succession of warm dry napkins. These depletory measures must be repeated if within a few hours the pain return, or the pulse resume its hardness. Of internal remedies, those are the most useful, in the first instance, which assist the bloodletting in producing an impression on the circulation, especially brisk purgatives containing mercury and antimony, which act fully on all the secretions. Calomel and James's powder, followed by an active draught consisting of salts and senna, generally answer best. Tartarised antimony is less effectual in this than in other inflammations of the chest: it may do harm if it excite vomiting; but in doses short of that effect it may prove useful.

It commonly happens that such measures take off the edge of the disease without destroying it entirely, or, at least, without removing its products, which must be a work of time; and although the pain, dyspnœa, and cough be much relieved, they are not removed, and the physical signs show that the effusion has taken place to a greater or less extent. Under these circumstances the proper means are those which promise to fulfil both indications, to reduce the remaining inflammation, and to promote the absorption of the matter already effused. The most powerful of these is mercury, which may be combined with ipecacuanha and opium, to lull the pain and to prevent the calomel from passing off too freely by the bowels. These remedies should be given in pills every three or four hours; and to them may be added digitalis or colchicum in a saline mixture, with an excess of alkali, to keep down the action of the heart and arteries, to determine to the kidneys and skin, and to lower the inflammatory condition of the blood. The beneficial influence of mercury is sometimes apparent when it does not affect the gums, especially in young subjects; its operation being only manifest on the hepatic and alvine secretion, which is green, dark, or high-coloured, from different conditions of the bilious matter in it: but in most cases the gums exhibit the effect of mercury before these secretions are produced.

Venesection can seldom be repeated with much advantage after the first few days, unless on the occasion of a fresh access of pain, or other symptoms which denote the renewal of acute inflammation. Occasional leechings continue to be useful; but, after the inflammatory fever has been reduced, the most effectual external remedies are blisters, which should be used large, and not left on too long; from six to eight hours is generally time enough to make them vesicate without inflaming the tissues too deeply, or irritating the system by the absorption of their serous discharge. Where the effusion is abundant, a succes-

sion of blisters will be necessary ; or they may be varied by a suppurating counter-irritant, such as the tartar-emetic ointment or solution.

The diet must be of the most spare kind in the early stage of acute pleurisy; and the patient should remain as quiet as possible in bed. But when the inflammation is subdued, sitting up, and, if the strength will permit it, using a little exercise about the room, will be beneficial in promoting the absorption of the fluid.

In limited varieties of pleurisy, such as those of a mild or partial kind, those excited by tubercles, and in those which occur in combination with typhoid or asthenic symptoms, the antiphlogistic measures above described must be reduced to suit the nature of the case, and the amount of the general strength. Circumscribed pleurisies may sometimes be removed by cupping or leeching only ; and in conditions of the system depressed by febrile or other morbid poisons, or reduced as in phthisis, blisters or sinapisms may be the only antiphlogistic means which can be borne. In continued fever, besides these external means and the usual salines, mercury in combination with opium is, according to our experience, the most appropriate remedy.

If, in severe cases, from insufficiency or delay of treatment, or in spite of it, the signs of effusion continue beyond two or three weeks, little or not at all diminished, with more or less constitutional disturbance, it is to be apprehended that the disease will take a chronic form, in which the character of the treatment must be to a certain extent changed. If the strength continue to diminish, the pulse be weak, and the fever (if present) of a remittent or hectic kind, a more nutritious and tonic plan must be cautiously pursued to the extent that the patient can bear ; the heat of skin, pulse, cough, and condition of the breathing being referred to as tests of the suitableness of the change. But external counter-irritation should still be continued, especially by blisters, which may perhaps be useful not only in reducing internal inflammation and in promoting the removal of the effusion, but also, as Dr. Stokes supposes, in restoring energy to the inactive external muscles of respiration, as they sometimes do to the muscles of a paralysed limb. The secretions must be kept free by medicines of a milder class than those used in the acute stage ; and, except with this object, we have not found much benefit from mercury in the advanced asthenic stages of simple pleurisy. In fact, when the effusion is purulent, the constitutional effect of mercury seems to be injurious. In these stages we have seen the most salutary effects result from the employment of the hydriodate of potass, which seems to act both as an alterative and as a diuretic. Dr. Stokes highly recommends iodine, both internally and externally, in the form of a pint of Lugol's mineral water daily, and from a quarter to half an ounce of the ointment rubbed into the side. We prefer the hydriodate simply, in the dose of two or three grains, three or four times a day ; and in the more asthenic cases, the iodide of iron in rather smaller doses. As there is apt to be in both these medicines some free iodine, which we believe to be the chief cause of the unpleasant symptoms which they are sometimes said to produce, it is well to direct the patient to eat a bit of bread or biscuit after each dose : the starch of this, combining with the free iodine, removes its injurious property ; and with this simple precaution we have administered both these remedies in numerous instances, for a great length of time, without ever inducing the gastric irritation and nervous symptoms which are commonly ascribed to iodine, and which we have seen produced even by Lugol's diluted solution. These medicines seem especially calculated to promote absorption ; and, combined with blisters, we have found none so efficacious in hastening the removal of a pleuritic effusion.

Various other medicines are occasionally useful. As diuretics, Laennec recommended acetate and nitrate of potash in very large doses, such as from ℥ss to ℥ij of the former, and ʒss to ʒiv of the latter, occasionally combining with them hydrochlorate of ammonia and squills. Where a dropsical diathesis prevails, we have occasionally found the tartrate of iron a good diuretic. But

in some such cases, a coagulable state of the urine sometimes indicates a state of the kidneys in which diuretics prove injurious. Under such circumstances, powerful purgatives and diaphoretics alternated are sometimes useful in reducing the effusion. But such remedies can seldom be used for any length of time without causing serious weakness and disorder, and are, we apprehend, more hazardous than the simple operation of mechanically drawing off the fluid.

Gentle exercise and friction are commonly serviceable in promoting the expansion of the chest and lungs, and the absorption of the fluid. In the more chronic cases, it is of the utmost importance to promote the general health by free exposure to a pure, mild, and suitable air; and in cases disposed to scrofula, this will be best found at the sea-side.

The removal of the fluid effused by pleurisy through an artificial opening in the chest (*paracentesis thoracis*), the utility of this operation, and its mode of performance, have long been, and are still, subjects of much question among both medical and surgical writers. We must refer to other works for the different opinions on these points: we shall endeavour to state in the simplest terms the general results of our reading, observation, and reflection on the subject.

There are two kinds of cases in which it becomes proper to give exit to the liquid accumulated in the pleural sac. One includes the examples of the recent disease, in which the effusion takes place so quickly and abundantly as to endanger life by the pressure which it causes on the lungs and bloodvessels. A sudden effusion may have this effect, where its quantity is not sufficient to compress the lung totally, or to displace the viscera to a great extent, especially if the lungs be previously disabled, as by emphysema, catarrh, &c.; there is, however, always some enlargement of the side, which, with dulness and absence of respiration and vocal vibration, will sufficiently indicate the nature of the case. Here the liquid is generally serum, with more or less lymph, and it commonly deposits a further clot of gelatinous fibrine after it has been drawn from the chest: the same liquid is however sometimes yielded by pleurisies of long standing. The other class comprehends those cases in which the pleurisy has existed for a long time; and the effusion, instead of showing a disposition to disperse under the influence of remedies, either increases or remains stationary; and whether it cause a dangerous degree of dyspnœa or not, its longer continuance must do mischief by perpetuating the compressed state of the lung, as well as by the various other structural and functional affections which we have before alluded to. The cases of true empyema are generally included in this number, and are considered the more legitimate subjects for operation, because there is less chance of purulent matter being removed by absorption; but we must add that the operation has not been so often successful in these cases as where the effusion is not purulent.

Now the object of the operation is to remove the fluid, which either from its quantity oppresses the functions, or by its quality extends and perpetuates the structural lesions of the chest and its organs. With this view, an outlet is given to it, any number of times, until its quantity is so far diminished and its quality improved, that it shall not prevent the re-expansion of the lung as far as that is possible; the contraction of the chest filling up the deficiency as the remaining fluid is afterwards gradually absorbed. It is easy to perceive that after the distension is relieved by the flow through the opening, the remaining fluid cannot be drawn out of the chest without something to occupy its place; and, unless proper precautions be taken, that something will be air, drawn by inspiration, not into the lung, but through the orifice into the cavity of the chest. Air thus introduced often seems to have the effect of causing an unfavourable change in the nature of the remaining liquid, rendering that which was serous decidedly purulent, and giving to pus a fetid character. Further, when air gets access, it tends to do mischief, whether the orifice remain open or be closed: in the former case, the air passing in and out prevents the lung

from expanding, and constantly irritates the serous membrane, which is not fitted for contact with it; and if it be closed, the air admitted tends to engender more air by the decomposition which it causes in the remaining fluid, so that the pleura soon becomes as much distended as before the operation. Hence, although the operation generally gives temporary relief, it has often been followed by symptoms of irritation, or of increased oppression, which have ultimately led to a fatal result. It is true that in some cases the cause of failure is irremediable disease in the walls or viscera of the chest, or perhaps in the constitution, which may be either the cause or the effect of a long continuance of the pleuritic effusion; but even in these cases, the operation may prove the means, either of great temporary relief, and considerable prolongation of life, or of just the contrary, according as it is, or is not, performed with due reference to sound physiological and pathological principles. The operation has, we admit, sometimes succeeded where these principles do not appear to have been much attended to; but this has been for the most part in young subjects, where the reparatory powers are active, and sufficient to countervail very unfavourable circumstances; and we are confident that it would succeed in many more instances, were it resorted to at the time in the way pointed out by our improved knowledge of the subject. One great error has been to delay the operation too long, until some of the bad consequences of the disease, such as obliteration of the tissue of the lung or deposits in it, surfaces secreting inorganisable matter, and incapable of adhesion, ulceration and even sloughing of the soft parts, caries of the bones, morbid deposits in other parts, and depression of the vital powers generally, prevent the possibility of recovery. Another great error we consider to have been in the neglect of all means to promote the re-expansion of the lung, which is the only natural mode of supplying the place of the fluid drawn off, and is an obvious step towards a restoration of the healthy condition of the parts.

The operation of paracentesis thoracis has been in use since the time of Hippocrates, and has been held in different degrees of estimation by the very numerous authors who have described it in its various modifications, but a great preponderance of opinion is in favour of its utility and safety when properly performed. It is very remarkable that many of the more important precautions in the operation were attended to by Hippocrates and his followers more than by the greater number of writers down to the present century; and we find from the "aphorisms," that the operation was considered to be the only means of cure, and when these precautions were attended to, and the fluid white and of good quality, the patients recovered. The chief of these precautions were, not to delay the operation after the existence of the empyema is known, and to draw off the liquid gradually, at successive periods, closing the wound in the interval. We must refer to works on surgery for details of the different modes of operating; and we would remark that from the time of Hippocrates to that of Laennec, although many new plans were proposed, little improvement had been made, and the credit of the operation had rather declined than otherwise; but the greater precision conferred by the latter author on the diagnosis and pathology of effusions in the chest, has furnished the means of rendering this operation more successful than it has hitherto been. Formerly the signs of the very existence of empyema and hydrothorax were so uncertain, that many patients have been tapped when there was no effusion: in many, the existence of empyema was not suspected until it had proved fatal, or produced changes which prevented recovery; and in many instances the almost hopeless lesion of tuberculous perforation of the lung and pneumo-thorax has been joined with liquid effusion, and its incurable character has thrown additional discredit on the operation. But now we have sure means not only of detecting the presence of liquid in the chest, but in a great measure also of discovering the complicated lesions, and of distinguishing the cases which give the operation the best chance of success. The same means also enable us to simplify the operation; for whereas formerly it was expedient to make a long incision with a

knife or lancet through the integuments, and then cautiously to divide the intercostal muscles and pleura with a bistoury, for fear of wounding the lungs or heart, now the surgeon, guided by the physical signs and the exploring needle, may without fear plunge a trocar at once into the chest, thus much diminishing the pain of the operation, and the risk of hæmorrhage.

Before describing the mode of operation which we would recommend, it is necessary to advert to some disputed points in regard to it. One respects the place for making the puncture. In case of the matter forming an abscess in the walls of the chest, there is no choice: this must be opened; but in the absence of such pointing, it is of importance to determine what is called the *place of election*. The majority of the older surgeons preferred the inferior parts of the chest, under the notion that the fluid would ponderate there. But as the fluid occupies the whole pleural sac, and by change of posture may be made to ponderate in any direction, this notion is of no weight in opposition to the risk of wounding the diaphragm and abdominal viscera in these regions. Accidents of this kind have repeatedly occurred. Laennec gives an instance in which a trocar passed between the fifth and sixth ribs on the right side, perforated the diaphragm and entered the abdomen; the diaphragm having been pushed up by an enlarged liver. In other cases, the liver, the kidney, and the lung have been wounded, the latter in consequence of its adhering to the diaphragm. On the other hand, the objection against puncturing the upper parts of the chest is chiefly on account of the greater frequency of adhesions of the lung there. The middle portions of the chest are therefore generally considered the most eligible, between the third and seventh ribs: and as the intercostal spaces are widest, and there is less thickness of the walls at the side, this part is generally selected as the place of puncture. Another debated point is, whether as much of the liquid as possible shall be evacuated at once, the aperture left open, and a canula inserted, or a little only at a time and the orifice closed. In regard to the quantity to be drawn off, we are fully persuaded, by the study of recorded cases, and by personal observation, as well as by reflection on the pathology of the case, that the Hippocratic method of evacuating the fluid *gradually at successive times, closing the orifice in the intervals*, is the best; both because it gives the lungs time to expand, and the vessels to adapt themselves to the diminished pressure, and also because it affords the best means of preventing the admission of air through the orifice. For the same reasons we decidedly disapprove of the practice of leaving the orifice open, and particularly of leaving a canula in it. In proportion as the air has free access to the pleural sac, it will irritate it, perpetuate its inflammation, and prevent the lung from expanding, even in cases where it does not cause decomposition of the remaining fluid. But in many instances the fœtor, which in the course of two or three days is perceived in the air and discharge which proceed from the orifice, becomes evidence of the latter mischievous effect of the introduction of air; and not a few patients have obviously sunk under the pernicious influence of the putrid matter thus generated. This result has ensued in some cases even where air has been admitted only in a very small quantity; and we therefore hold it to be highly desirable to prevent the entrance of any air. We are surprised that Dr. Townsend, who otherwise advocates the plan of the gradual discharge of the fluid, and the closure of the orifice, expresses a doubt whether the admission of air be really hurtful, and supports the doubt by the experiments of Nysten and Speiss, who found that air introduced into the healthy pleura was invariably removed by absorption in the course of a few days. These are obviously not parallel cases, and it is highly improbable that air admitted to a serous cavity whose absorbing properties are manifestly impaired, the membrane being covered with products highly disposed to decomposition, will be absorbed without further mischief. To prevent the admission of air, it has been lately proposed to puncture the chest under water, the patient being in a warm bath; and this expedient is well worthy of attention, particularly in cases where, from the long continuance of the disease, and consequent loss of

expansibility of the lung, and elasticity of the walls of the chest, the method to be described afterwards may be insufficient. Several writers have recommended liquid injections with the view both to expel the air and to facilitate the discharge of the matter. The ancients in some cases injected oil and wine to promote the healing of the cavity; and it has repeatedly been tried, and sometimes with good results, to attain this by aromatic and tonic vegetable infusions. Sir P. Crampton used with success an injection of a weak solution of chloride of lime. However useful these injections may be for these purposes, they must in some degree prevent, rather than favour, the re-expansion of the lung. To attain this point, as well as to increase the discharge of the liquid, it has been attempted to suck the latter through the orifice, by means of different kinds of syringes. Laennec proposed using a cupping-glass with an exhausting syringe after the puncture: this contrivance would probably draw off the fluid and promote the expansion of the lung very effectually; but unless the operation be conducted with great care and gentleness, there may be danger of rupturing the lung by the forcible entry of the air into it, or it would be almost impossible in the mode proposed by Laennec to prevent air from entering through the puncture on removal of the cupping-glass. Still we think that the expedient might be useful and safe by means of a little management, by which the canula should be slipped out, and the integuments drawn over the puncture, so as to make it valvular before the cupping-glass is removed, when the orifice might be further secured by means of a compress confined by strips of adhesive plaster.

But we apprehend that the exclusion of air as well as the expansion of the lung, as far as that can be safely attempted, may be effected by applying manual pressure to the walls containing the effusion, and by closing the orifice before that pressure is removed. The following is the manner in which we recommend the operation generally to be conducted.

The spot for the introduction of the trocar must be determined with due reference to the physical signs; carefully avoiding every part where or near which there is sound of respiration, voice, or not perfect dulness on percussion. A projection and fluctuation of an intercostal space give greater eligibility to a spot; and these circumstances present themselves most frequently at the inferior lateral parts of the chest from the third to the seventh rib, where also the soft walls of the chest are as thin as any where. In all cases it is a proper precaution to pass a grooved needle first, as recommended by the late Dr. Thomas Davies; for this at once determines the presence of the liquid, its quality, and the thickness of the walls which contain it at that spot. Of course it is proper to avoid the immediate vicinity of the heart or of any of the known arteries or nerves. The upper margin of the fifth or sixth rib most commonly presents a favourable spot, but whether more or less at the side must be determined by the position of the heart and other circumstances. The patient should be lying on his back, inclining to the affected side, and not more raised than is necessary for the state of his breathing. The skin should be drawn aside, so that the puncture through it may not, after the trocar is withdrawn, correspond with that of the costal pleura, but form a valvular orifice. The trocar should not be pushed in further than is necessary to clear the parietes; but the canula may be pushed in further after the stilette is withdrawn, and its sides should have several holes in them. As soon as the stilette is withdrawn, steady pressure should be applied by a bandage or by the hands of assistants, to depress the shoulder and ribs, and to push up the diaphragm on the affected side, to promote the flow of liquid and to prevent the introduction of air through the orifice during any sudden or forcible act of inspiration. For the same reason, during a fit of coughing, if there appear any tendency to intermission in the stream of liquid, the orifice should be closed by the finger. The pressure should be steadily increased as the liquid flows; and if the stream should stop, a probe may be passed through the canula to clear it of clots of lymph or any other obstructing matter; but if still no more flows, a compress, or if the liquid

is purulent, a large poultice should be placed on the orifice; and then, but not till then, the pressure on the walls of the chest may be discontinued. The result will be, that the walls of the chest, expanding by their own elasticity on the removal of the pressure, will draw air into the compressed lung, which, being thus inflated, will begin to resume its part in the function of respiration and circulation, and will thus promote the absorption of the rest of the fluid, and improve the condition of the whole system. Even if the fluid should accumulate again, the temporary expansion of the lung will have served to restore its natural properties, so that when another quantity of fluid is again withdrawn, its tissue will be better prepared for a restoration of its function.

Performed in the manner as directed the operation is almost free from risk, and will seldom fail to give relief. If the liquid be purulent it will generally be necessary to repeat the operation several times; but if it be serous, one tapping, which will partially expand the lung, will often be sufficient to give a turn to the disease, its complete removal being effected by nature aided by appropriate remedies.

When the fluid is purulent, we should strongly recommend the injection of warm water with the view to displace it; but instead of doing this, as it is usually practised, with a single tube, it should be done through a double-tubed canula, the tube for injection being cautiously carried two or three inches into the chest, whilst the evacuating tube is merely long enough to pass through the walls. If warm water previously boiled be then thrown in through the long tube by Read's syringe, it will drive the matter through the short tube; and in this way the greater bulk of the secretion will be displaced by water, which is very likely to be absorbed. If after repeated evacuations there be no apparent disposition to the expansion of the lung or contraction of the chest, and matter continues to be secreted, it may be useful to use medicated injection, such as a very weak solution of nitrate of silver, or chloride of soda. The pleural sac may be treated as an abscess, and if the discharge be unhealthy it is quite proper to correct it and to promote the healing of the diseased parts by such means as are known to promote granulation and desiccation of suppurating wounds. When the discharge is fetid, it is more decidedly necessary to correct it by injections of chlorinated solutions, mixtures of creasote, or other antiseptic liquids. The same practice may be advantageously pursued when the matter has pointed and opened spontaneously, leaving a fistula which may remain open for months and even years. Dr. Townsend mentions the remarkable case of Dr. Wendelstadt, who had been tapped thirteen years before, since which time the wound had remained open and discharged daily to an amount varying from half a drachm to four ounces. The diseased side was much contracted, and did not move in breathing, yet he could blow the flute, walk fast, and actively perform his professional duties.

PNEUMOTHORAX.

Modes in which it may arise.— Physical signs. — Prognosis. — Treatment.

Pneumothorax (from πνεῦμα, air, and θώραξ, the chest) implies the presence of air in the cavity of the chest. The discovery of this disease, or rather of this effect of other pulmonary lesions, is of modern date, though it for a long time received no distinctive name till the term pneumothorax was proposed by M. Itard, and subsequently adopted by writers on pulmonary diseases.

Pneumothorax may be produced in three different ways: — 1. It may be the consequence of a partial pleurisy. We have mentioned, that after a pleuritic effusion has long compressed the lung, and the compression has been perpetuated by a rigid false membrane formed over it, the absorption of the liquid leaves a void, which the collapse or contraction of the walls of the chest is in

some cases insufficient to obliterate, and this void is sometimes filled with air secreted by the membranes. We have seen two instances of partial pneumothorax produced in this way. They each occupied about half of the pleural sac; in one case the upper, in the other the lower half; and the lung in both cases was strongly bound down by fibro-cartilaginous membrane, and condensed in the part contiguous to the empty space. There was also some contraction of the chest in both cases. This kind of pneumothorax is very rare.

2. Another kind of pneumothorax is that which may be called idiopathic, and arises from an effusion or secretion of air into the sac of the pleura without perforation. This is also of very rare occurrence. It is said to occur sometimes towards the termination of fatal diseases, in the same manner as tympanitis occasionally occupies the peritoneal sac under similar circumstances. We have never met with such a case in which the signs of pneumothorax were observed during life; but we have several times seen a little air in the pleural sac when it is opened after death, without any discoverable perforation of the pleura. It is possible that a little air may have been exhaled from the animal fluids after death, and then increased by exosmosis through the lung: the facility with which gases pervade dead membranes countenances such a notion. Pneumothorax is also said by Drs. Hudson, Graves, and others, to have occurred in a few instances at the commencement of pneumonia, and to have soon afterwards disappeared: but as the chief sign in these cases was a remarkable resonance on percussion, we suspect that these were examples of the production of tracheal or amphoric sound, from consolidation of the upper lobe of the lung, and not cases of pneumothorax.

3. By far the most common kind of pneumothorax is that caused by some unnatural communication between the pleural sac and the external air, and this may be by a perforation either of the external parietes or of the pulmonary pleura. The latter case is now recognised as the usual cause of pneumothorax, and constitutes the great bulk of the examples that are met with. The perforation depends on the progress of the ulceration, generally of tuberculous character, rarely of gangrenous abscess, through the pleura. The circumstance of ulceration reaching and perforating the pleura indicates a low state of the reparative powers, and a want of plasticity in the products of inflammation; for under ordinary circumstances ulceration could not approach the pleura without causing it to inflame and throw out coagulable lymph, which becoming organised, forms either a protecting thickness of membrane, or close adhesions to the costal pleura. We see this in most cases of chronic phthisis, where the upper lobes are generally adherent to the ribs. We have seen ulceration extend from a tuberculous cavern across the two layers of the pleura, thickened and adherent, and completely through the walls of the chest, so that when the patient coughed, air bubbled out of two or three fistulous openings in front of the chest, but there was no pneumothorax. On the other hand, we have met with more than one case in which the adhesive process seemed quite incapable of protecting the pleura, which was consequently perforated at several points, wherever in fact the ulceration of the lung reached it, and air freely passed into the pleural sac by all these holes. More commonly, however, there is only one perforation; and this is generally near the apex of the lung, in connexion with some of the cavities which first form there.

The completion of the perforation is in most instances sudden — a part thinned by ulceration, and imperfectly adherent, giving way during a fit of coughing, or some other unusually forcible act of respiration. We have met with an instance in which external violence produced the rupture. The immediate effect of the perforation is to admit air more or less rapidly into the pleural sac, which by equalising the atmospheric pressure outside and inside of the lung, permits it to assume that state of collapse to which its natural elastic contractility would reduce it. Hence dyspnœa, sudden and severe in proportion to the extent to which the air enters and the lung becomes collapsed. But the access of air to a serous membrane totally unaccustomed to it, with perhaps the discharge of

matter from the ulcerous opening, also occasions great irritation and consequent inflammation of the pleura. Hence a sudden sharp pain and dry cough, with spasms of the intercostal muscles, and a weak, quick, and sometimes irregular pulse. Soon the irritation becomes accompanied with inflammatory reaction, and then follow the symptoms of acute pleurisy with heat of skin and inflammatory pulse; and liquid effusion is added to the air in the pleural sac.

Although a perforation of the pleura will not fail to introduce air into its sac, the amount and effect of this introduction of air will vary considerably according to the size and other conditions of the ulcerated opening. If this be very small, or if, as it not unfrequently happens, it be so placed that the walls of the chest close it in expiration, by which it is rendered valvular, or if it be below the level of the liquid, the air introduced by each inspiration will not escape as freely in expiration, and the result will be the progressive accumulation of air in the pleura, and a consequently increasing compression of the lung and dyspnœa; and in this way perforation of the lung has in some cases caused suffocation within a few hours of its occurrence; in others this catastrophe has been delayed by the egress of the air by accidental changes of position, by violent coughing, or by puncturing the chest. If the aperture be of larger size, and no impediment occur to the passage of air through it, it will interfere with respiration only so far as it suffers air to pass outside of, instead of into, the lung. But when the air passes thus freely, the pleura is more irritated by it, and there is a more copious secretion of liquid, which is generally more or less purulent and often fetid. In either of these cases, after the subsidence of the spasm, pain, and dyspnœa, first caused by the entry of the atmospheric air, there are no characteristic general symptoms which can serve to distinguish pneumothorax. The occurrence of perforation may sometimes be suspected from the sudden supervention of acute pain of the side and oppression, which the patient in some instances refers to something having given way during a fit of coughing. But such sudden attacks sometimes take place from pleurisy without perforation, and we have repeatedly known perforation happen without being followed by any remarkable increase of pain or distress.

The *physical signs* of pneumothorax are generally very remarkable and distinctive. The presence of air in the pleura will give to the walls of the chest a freedom of vibration, and therefore a degree of resonance on percussion, even greater than that which the air-filled structure of the lung confers upon them; so that percussion will give more of the drum-like note or tone which is obtained by striking on the region of the stomach or cæcum. This is more marked in proportion as the quantity of air is considerable. The same circumstance will also impair or destroy the sound of respiration; for the air not only removes to a greater distance the pulmonary structure in which this sound is produced, but also by its pressure diminishes that entrance of air into the cells on which the sound depends. There will be therefore this remarkable contrast of signs to distinguish pneumothorax—a clear or hollow sound on percussion, with little or no sound of vesicular respiration, whilst the healthy side gives a duller sound on percussion, but a much more distinct respiratory murmur.

There is however produced in air-filled cavities another class of sounds, which often gives decisive evidence of their existence. The character and cause of these sounds may be shown by a simple experiment. If the mouth of a caoutchouc bottle be held to the ear, and its outside struck, each stroke causes a short tinkling note, like the clink of a piece of metal or glass. This note is a kind of echo, produced by the reverberations or repeated reflections of the impulse from the walls of the cavity, and it is shrill and acute because the reflections are short and quick in so small a space The same kind of note may be heard in other hollow bodies, such as an empty cask; but it is there less shrill, because the space is larger. Any sound proceeding from, or communicated to, the interior of the cask, the caoutchouc bottle, or any cavity in the body with reflective walls, will be accompanied or followed by this sort of

tinkling or ringing echo, which will be more prolonged and distinct in proportion as the walls are perfectly and uniformly reflecting. Sounds of this kind may often be heard on using the stethoscope over the stomach and large intestines, as their contents move and cause a sound within them. So too this tinkling echo may accompany the sounds proceeding from an air-filled cavity in the chest, and it becomes a distinctive sign of the existence of such a cavity.

In idiopathic pneumothorax, and in that partial kind resulting from the absorption of a pleuritic effusion confined by adhesions, although the cavity be present, there may be no sound produced in it, or transmitted to it, so as to cause the tinkling echo. Sometimes percussion on the external walls will do this; and we have heard the metallic tinkling accompany both the voice and the cough in a case of partial pneumothorax without liquid effusion or perforation of the pleura, the sound being transmitted to the cavity through the condensed tissue of the lung. But it is where the pleura is perforated and where liquid is present, that the phenomenon of metallic tinkling is commonly heard; not, as Laennec supposed, because these conditions are essential to its production, but because the motions of the liquid or of the air through the orifice make sounds within the cavity which serve to show its echoing properties. So metallic tinkling has often been heard after the operation for empyema, manifesting the presence of air in the pleura.

Perforation of the pleura, with its consequence, pneumothorax and liquid effusion, is not a very uncommon accident in the course of phthisis; and its signs are so remarkable, that they can scarcely fail to be recognised even by those who are but moderately versed in auscultation. The tinkling echo may present several modifications, which it is useful to notice, as they serve to give a more accurate knowledge of the condition of the parts and of their tendencies. When the perforation is small, or obstructed by its position against the walls of the chest or below the level of the liquid, the tinkling is seldom heard except on coughing or taking a full breath, which reaches the cavity and may throw the liquid into bubbles. The voice may also sometimes reach the cavity through a consolidated portion of the lung, and then it will be accompanied by a tinkling. When the orifice is large and free, the air will pass in and out in ordinary breathing, and will produce in its vicinity a sound like that of blowing into the mouth of a glass bottle: this kind of respiration is therefore called *amphoric*. In such cases there is seldom so much oppression of the breathing as in those where the air passes less freely and accumulates in the cavity. In listening for the tinkling phenomena, it must be held in mind that they may be audible only in certain parts of the chest where the lung is not adherent, and where the liquid effusion does not reach. Generally, in the sitting posture they are heard best about the mammæ and the lower part of the scapula and axilla; but we have heard them in some cases in every part of the affected side, and in others only in one spot. In fact, there must be a certain degree of tension in the walls of the cavity to make them good reflecting surfaces, and if this be deficient at the spot of the cavity opposite to that on which the stethoscope is applied, the sound may be absorbed and not reflected.

The addition of the liquid to the air in the chest makes the diagnosis still more easy. By percussion we can find the exact level to which the liquid rises, and that this level moves with change of posture; this is much more distinctly perceptible than with simple liquid effusion. The motions of the liquid may further give very decisive evidence of its presence with air in the cavity. On change of posture and on coughing, the liquid will sometimes drop from the parts which have just been immersed; and the sound of this will exhibit the metallic ringing in so distinct a manner, that it resembles the note which a glass or porcelain vessel yields when struck. If the liquid be agitated more forcibly, as by the patient giving his trunk an abrupt jerking turn, or being violently shaken, it may be heard to splash most distinctly against the walls of the chest: this is the sign of *succussion* described by Hippocrates. It

may be best heard by applying the ear to the chest at the time of the movement, and then the tinkling is heard to accompany it, and sometimes to follow it as the liquid drops from the sides, or the bubbles break on its surface. The splashing is not easily produced, unless there be a good deal of air in the pleural cavity with a moderate quantity of liquid. The proportions of these are however better ascertained by percussion.

The *prognosis* of pneumothorax from perforation must be generally unfavourable, because, besides its own formidable character, in the vast majority of cases it arises from tuberculous disease of the lungs. Provided however the tuberculous disease be very limited, it does not seem unreasonable to think with Laennec that the case may not be entirely hopeless. Laennec mentions an instance in which pneumothorax lasted for six years. Dr Houghton describes another in which the individual survived the perforation eighteen months, and probably would have lived longer if he had not imprudently exposed himself in his work as a bricklayer; for the signs of the cavity had disappeared, the side had contracted, and the general health had been much improved. In a case related by Dr. Stokes the patient lived for many months, during which he rode much on horseback, and could hear a splashing in his chest when he trotted or cantered. We have known two patients with pneumothorax leave the hospital with the impression that they were nearly well, having gained flesh, and lost the worst phthisical symptoms after the first severe consequences of the perforation had subsided. In such cases, which are to be considered exceptions to the general rule, the production of the new disease in the pleura seems to act favourably in retarding the tuberculous affection of the lung; and if this be of limited extent, it is possible that it may be removed, the wound on the lung cicatrised, and the cavity of the pleura obliterated by contraction and adhesion.

Treatment. The measures calculated to relieve the symptoms of pneumothorax with perforation vary considerably according to the period of the lesion, and the condition of the system. In the first instance the perforation and access of air and matter to the pleural sac is often attended by considerable prostration of the system with rapid feeble pulse and faintness, together with the pain and cough, which are then the result of irritation rather than inflammation. Considerable doses of opium or morphia are necessary to allay this irritation; they may be advantageously combined with calomel and antimonials; and sinapisms or warm fomentations may be applied to the affected side. More active antiphlogistic measures cannot be used until the reaction takes place, which generally begins in a few hours, bringing with it heat of the skin, strength and hardness of the pulse, and great soreness as well as pain of the whole affected side; then bloodletting, chiefly local, must be used, with aperients and salines, according to the strength of the patient, and the degree of fever present. These may be followed by blistering or tartar-emetic counter-irritation in proportion to the continuance of the inflammatory symptoms. But it is not to be forgotten that perforation of the pleura and its consequences are almost always added to a previously existing disease, tuberculous phthisis: and the degree of advancement that this may have reached must much limit the propriety and efficacy of the measures for this accidental inflammation that has been excited. The same considerations are to be kept in view when, in consequence of the smallness of the perforation, or its valvular condition, air accumulates in the chest and becomes the cause of oppressive dyspnœa. The immediate indication in this case is, doubtless, to give exit to the air by puncturing the chest; and this has been done in several instances with great temporary relief. But before this operation is prescribed, it should be considered whether, as the relief from it will be but temporary, the condition of the patient be such as to make this likely to outweigh the pain and risks of the operation. These certainly are not great; but when added to the dubious view in which the friends of the patient may regard an operation which proves but imperfectly successful, they are sufficient to deter us in many cases from re-

commending it. The case is different when the accident occurs before the consumptive disease has advanced far, when there is much flesh and strength, and when the physical signs have shown that there is a large proportion of sound lung. The operation may be repeated if the air accumulate again. As it is impossible to avoid the continued introduction of air into the chest, the mode of performing the operation is a matter of much less consequence than in empyema. It is more desirable to puncture below the level of the liquid, to allow this as well as the air to escape.

PLEURODYNIA.

Nature and characteristic symptoms of the various kinds of pain in the chest, and their treatment.

The affection usually called Pleurodynia is generally considered to be of a rheumatic character, either in the intercostal muscles, or in the fibrous fasciæ lining the chest. If it occur singly, it may be of little consequence; but if connected with constitutional rheumatic disease in other parts, whether attended by much fever or not, it is not to be lightly thought of, for it may readily be converted into a pleural or pericardial inflammation.

It not unfrequently happens in sensitive frames, particularly those of females, that an acute pain suddenly seizes some part of the chest, causing shortness of breath and perhaps cough, very like the stitch of pleurisy: but there is no heat of skin, and the pulse, although often quickened, is not hard. The respiratory motions and sounds may be diminished by the restraining influence of the pain; but the other physical signs of pleurisy are wanting. There is no friction sound, or dulness on percussion; but there is sometimes a continued dull rumbling sound produced by the vibrating contraction of the muscles, which is kept up by the sensation of pain. These affections appear to be neuralgic, and are often connected with a condition of the system the very opposite of inflammatory, such as that which comes on after considerable losses of blood, or when the blood is in an impoverished state, as in chlorotic females. Sometimes they occur in connexion with the periodic plethora of irregular menstruation, and are relieved when the catamenia flows. In such cases bloodletting relieves the pain, but often at the expense of the natural function.

There are other kinds of pain in the chest which may be called nervous, such as those associated with indigestion and a disordered stomach: they are generally referred to the sternum, and in the case of gastrodynia are so severe, as to cause great apparent dyspnœa. Pains are also felt in the chest and shoulders, from a congested state of the liver

The *treatment* of nervous pains of the chest must be directed more to the condition of the system inducing them, than to the part which seems to be most affected; for it may be at one time the chest, at another the abdomen, or a limb that is the seat of these pains. Sinapisms, hot fomentations and stimulants, or anodyne liniments or plasters, will generally relieve the pain. Where the nervous irritation seems to arise from an undue depression or depraved state of the vascular functions, as in chlorosis, the careful administration of tonics, especially steel medicines, with due attention to the state of the excretions, will be most beneficial. When the pain seems to be the result of misdirected rather than of excessive nervous influence, as in amenorrhœa without chlorosis, those remedies are indicated which tend to draw blood and nervous irritation towards the uterus, such as small doses of aloes, the hip-bath, and for a more continued effect, wearing flannel over the hips and thighs, and riding on horseback. If blood is to be drawn at all for temporary relief, it should be by leeches to the inside of the thighs. The application of three or four every night for four or five successive days, sometimes brings on the natural

relief when all other means have failed. If there be much tenderness at any part of the spine, all the symptoms may sometimes be relieved by leeches applied to that part.

Nervous pains unconnected with menstruation may be treated with narcotics both externally and internally. Pleurodynia of a rheumatic kind will require the treatment commonly useful in the form of rheumatism, with which it happens to be associated. It is not necessary here to enter into further details on these subjects.

PNEUMONIA.

General symptoms of acute pneumonia. — Anatomical characters. — Sanguineous congestion. — Red hepatisation. — Suppuration, or yellow hepatisation. — Gangrene. — Physical signs. — Indications by physical signs of the situation, extent, and stage of pneumonia. — Varieties and complications. — Typhoid pneumonia. — Complication with bronchitis — with pleurisy, constituting pleuropneumonia — with phthisis — with the various forms of fever. — Pneumonia and purulent deposits in the lungs after injuries and surgical operations. — Diagnosis. — Prognosis. — Causes. — Treatment of the first stage — of the second stage — of the third stage. — Application of the treatment to particular cases. — Of chronic pneumonia — its anatomical characters, symptoms, and treatment.

Pneumonia Gr. πνευμονία, *peripneumonia*, περιπνευμονία, *pneumonitis*, *pulmonitis* (from πνεύμων, *pulmo*, a lung, or the lungs), are names given to inflammation of the parenchyma of the lung. These terms were applied by Hippocrates and other ancient writers to most of the acute diseases of the chest unattended with severe pain, those connected with this symptom being by them termed *pleurisy*. Although this ground of distinction by no means holds good with our improved knowledge of the subject, yet we shall find, in opposition to the opinion of Cullen and some modern writers, that between pneumonia, pleurisy, and bronchitis, there is a distinction founded in pathology, and most important in practice.

The characteristic symptoms of pneumonia may be given as follows: — fever, with more or less pain in some part of the chest; accelerated and sometimes oppressed breathing; cough with viscid and rusty-coloured expectoration; at first the crepitant rhonchus, afterwards bronchial respiration, and voice with dulness on percussion in some part of the chest. We shall find, however, that many of these symptoms are not essentially connected with pneumonia, which, with more precision, may be defined pathologically, as inflammation and its product in the parenchyma of the lung.

Symptoms. Acute inflammation of the lungs is, like other phlegmasiæ, accompanied by fever, which often commences with rigors prior to any other symptoms, but sometimes preceded by the local symptoms. The fever is generally very intense, and in plethoric individuals accompanied by flushing of the face, injection of the eyes, headach, and other signs of local determination of blood. The pain in the chest, which when present usually appears early, varies much in degree, being sometimes intense, and sometimes diffused and dull; frequently it is a deep-seated feeling of heat and weight rather than of pain. It generally seems to be deep-seated in the chest, under the sternum, the breast, or the scapula; when more at the side, it is often more acute, and this is frequently, but not always, caused by the extension of the inflammation to the pleura. There is commonly more or less cough, which aggravates the pain: it is short and dry at first, or accompanied with scanty mucous expectoration, and is by no means proportioned to the intensity of the inflammation, being in some cases so slight as to escape notice. The shortness or quickness of breathing is also an early symptom, and a better index of the extent of the disease: but it is to be judged by the number and forced character of the respirations,

rather than by the feelings of the patient which are often deceptive. The number of respirations in a minute (which in the healthy adult is about twenty) may rise to thirty and upwards. In some cases, particularly where the attack has been sudden, or has supervened on previous disease of the lungs or heart, the dyspnœa is more urgent, obliging the patient to assume a particular attitude, which is commonly on the back with the shoulders elevated. Muscular efforts, and particularly speaking, bring on or increase the oppression. The pulse is quick, and in most instances sharp; sometimes but less commonly it is hard, and it generally loses this character as the disease advances. There are moreover the other symptoms of fever, such as thirst, furred tongue, loss of appetite, scanty and high-coloured urine, pain in the head and limbs, and weakness. If blood be drawn it exhibits the buff coat. The febrile irritation varies greatly in character, sometimes affecting particular organs, as the brain, causing delirium; the stomach, inducing sickness; the liver, giving rise to jaundice, and other bilious symptoms; and in many cases the fever, instead of being inflammatory is typhoid, producing a variety of the disease which will be afterwards noticed.

In the course of a day or two the cough becomes accompanied by the expectoration of a rusty-coloured sputum of various shades, semitransparent, tenacious, and coherent; at first it does not differ from that of acute bronchitis except in colour, which is light reddish or rusty, sometimes passing into an orange yellow or even a greenish tint: as the disease proceeds, the tint becomes more pronounced, and the viscidity greater. When the characteristic sputa appear, the dyspnœa is often increased; and if the pulmonary inflammation be extensive, the oppression is urgent. The pain on the other hand is often diminished, though sometimes it continues and prevents the patient from lying on the affected side.

In favourable cases the disease may decline on the third or fourth day, with a general alleviation of the symptoms. This is generally first evinced by the skin becoming more cool and moist, and the expectoration less tinged and viscid, and more abundant and opaque, like that of declining bronchitis. Sometimes the improvement is rapid, the patient being restored to convalescence in six or eight days; but it is often more protracted, slight exacerbations recurring every evening, and prolonging the disease for a fortnight or more. The quickness of pulse, cough, and slight dyspnœa are the symptoms which are most apt to linger, with the temporary recurrence of the sanguinolent tinge in the sputa: these are to be regarded as signs of a lurking disease, which a slight cause may aggravate and bring to a relapse. In more formidable cases, the increase of the disease is apparent on the third or fourth day, by the quickened respirations (sometimes amounting to forty or sixty in a minute), occasionally obliging the patient to sit up; sometimes by more frequent cough, though this is by no means constant; by the greater viscidity and deeper tinge of the sputa; the more weak and rapid pulse; more depressed state of the bodily powers; the loaded or dry tongue; the hot skin, or its feeling cold and partially perspiring. Sometimes there is delirium or coma, which are dangerous symptoms, especially in old persons, and often disguise the nature of the disease. Laennec justly describes comatose symptoms as of more unfavourable import than fierce delirium.

The progress of fatal cases is marked by increasing failure of the strength and more hurried breathing, but the feeling of dyspnœa is not always increased in proportion, sometimes it is even diminished. The cough is less effectual in discharging the sputa, which sometimes retain their viscidity and sanguinolent hue. In most instances there is a total suppression of the expectoration for some hours before death; in others it is still voided, but in an altered state, being a thin transparent or dirty mucus, or an opaque dirty brown or greenish fluid, consisting of a mixture of mucus and pus, with a little blood. In some cases it has a very fetid odour; in others the thinner reddish brown fluid, noticed by Andral, like prune juice or liquorice-water, is that last expectorated. With these changes in the expectoration, the pulse becomes thready, very frequent, and often irregular; the countenance pallid and ca-

daverous; the lips livid; the skin cold and bedewed with cold sweats; the breathing gasping, with an increasing rattle in the throat; the sensorial functions give way, and the patient dies asphyxiated.

When the disease terminates favourably, the amendment is often accompanied by some critical evacuation, such as perspiration, a lateritious deposit in the urine, expectoration, diarrhœa, epistaxis, hæmaturia or some other hæmorrhage, or the menstrual discharge: of these the four first are by far the most common, and the two first are often conjoined; but the critical evacuation varies with the cause of the disease and the nature of the prevailing epidemic. The observations of Andral have in some degree confirmed the opinions of Hippocrates and other authors, ancient and modern, that on certain days the symptoms show a tendency to abate. These are especially the seventh, eleventh, fourteenth, and twentieth days. In ninety-three cases observed by Andral, the recoveries on critical days averaged fourteen, on non-critical little more than three. In these favourable cases, after continuing with greater or less intensity for the various periods just mentioned, the symptoms become evidently ameliorated: the dyspnœa subsides; the cough becomes less constant and more easy; the expectoration less viscid and tinged, and more opaque and free; and the pulse less frequent, often with an increased fulness. The fever also abates: the skin becomes cool, soft, and moist; the tongue cleaner, and the thirst abates. Some quickness of breathing and of pulse generally linger after the other symptoms, and often cough with bronchitic expectoration, which may remain for some time, and pass through the changes observed in acute bronchitis.

In recovery from pneumonia, relapses are by no means uncommon: they are marked by a recurrence of the chief symptoms, pain, shortness of breath, cough, and viscid sanguinolent expectoration. The fever is less acute than at the first attack; hence a relapse, if serious, may be less tractable.

We shall have occasion to revert to the character and variety of the general symptoms, when treating of the pathology of the disease and the physical signs.

Anatomical characters. The first condition produced in the lung by inflammation is *sanguineous congestion* or *engorgement*, in which the vessels are then so much distended, that the whole tissue appears red, of different shades, and is much heavier than usual, but still crepitates. In some cases a frothy serum exudes when a section of the lung is made; this is probably the effect of the coagulation of the blood after death, for it is not observed in those cases in which the blood remains fluid. It is a common notion that the blood in an inflamed lung is effused into the air-cells, but for several reasons we are inclined to believe that it is contained chiefly in the distended vessels and in the tissue, although it may be occasionally extravasated. Andral examined an inflamed lung after drying and slicing it, and the only difference which he could perceive in its structure was, that the membranes between the cells were somewhat thicker and redder than natural; but there was not that obliteration of the cells that might have been expected if they had been filled with blood. In typhoid pneumonia, and that from asphyxiating gases of the sedative kind (such as those generated in sewers), the inflammation often does not go beyond this stage, and when it does, it passes at once into a half gangrenous, half purulent destruction of the lung, there being apparently in these cases some change in the vital properties of the tissues, or in the condition of the blood, which incapacitates it from supplying coagulable lymph, the deposition of which constitutes the next stage.

The second stage of pneumonia, *red hepatisation* as it is called, brings the lung to a state of solidity more or less approaching that of the liver. But the transition from the first stage is not sudden but gradual, being the result of the same overflow of the nutritive function, which causes the effusion of lymph in the inflamed pleura. The tissue of the lung, thus consolidated, is so heavy that it generally sinks in water; but it is also more fragile than usual,

so that, on being pressed, it breaks down under the finger. This softening seems to be chiefly the consequence of the interstitial deposit of soft fresh lymph, which diminishes the molecular cohesion of the tissues; and the more acute and recent the inflammation is, the greater generally is the softening. The colour of a hepatised lung varies much according to the quantity of blood left in it: if this be much, it is red; if little, pinkish brown; or reddish grey, if mixed with the black pulmonary matter. The deposition of lymph seems to supersede the red particles, or possibly it may be formed at their expense. When a hepatised lung is cut into or torn, numerous little granulated points, of the size of pin-heads, and of a lighter colour than the rest, are often observed. These granules Andral first represented to be the single air-cells or terminations of the bronchi, and he conceived that they were distended with the same viscid mucus secreted by their mucous linings, which is seen in the sputa. Laennec considers these little bodies, the air-cells, converted into solid grains, by the thickening of their parietes and the obliteration of their cavities by a concrete fluid. From many minute examinations which we have made, we have been long convinced that the granulations of hepatised lungs contain no appreciable quantity of viscid mucus, but that they are probably portions of vesicles and minute tubes, with their tissues distended with an interstitial deposit of lymph, and occasionally having the same matter in their interior. In his work on *Pathological Anatomy*, Andral has expressed a similar opinion. But hepatised lungs do not always present this granulated appearance; sometimes there is a uniform condensation of a deeper red than usual. This condition Andral refers to a more complete obliteration of the cells, a further degree of solid effusion; but this would not agree with its redder colour. We are disposed to view this non-granular kind of hepatisation as the result of inflammation confined more to the plexus of vessels and intervesicular tissues, and less affecting the membranes forming the cells: hence the consolidation partakes more of the character of the vessels and the blood which they convey, and less of the lighter coloured deposit which the membranes of the cells secrete. The recent researches of MM. Hourmann and Dechambre, on the pneumonia of the aged, confirm this view: they have been led to distinguish the granular hepatisation from that of a more uniform aspect; and they designate the first as the result of *vesicular* pneumonia, the other of *interlobular*. Having been the first to describe the latter as a separate form of pneumonia, we prefer the term *intervesicular*. When the blood remains fluid, the consolidation is imperfect, and the portion of lung thus affected, although it may sink in water, is quite soft and resembles the substance of the spleen rather than that of the liver; hence it has been called *splenisation*.

The hird stage to which inflammation brings the lung, is that of *suppuration*, or *yellow hepatisation*. This consists in the conversion of the semi-solid particles of lymph or blood, which constitute the solid or red hepatisation, into an opaque, light-yellowish, soft, friable matter, and finally into a liquid pus. This suppuration is commonly diffused in the form of purulent infiltration; and it is rare to find it assume the character of a distinct abscess. We see a sufficient reason for this in the very porous structure of the lung, which renders the circumscription of the matter by the effusion of lymph, such as that which takes place in abscesses in general, a very unlikely result; and the life of the patient, or the vitality of such a delicate and porous structure as that of the lung, is generally destroyed before the process of suppuration can be completed. Hence, even where the suppuration has advanced furthest, there is generally much of the tissue of the lung remaining, and a gangrenous condition is often added to the suppuration, giving the matter a very offensive odour. Nevertheless, circumscribed abscesses in the lung are now and then met with, and this is generally when the inflammation is limited, or more intense in one part, so as to tend to the early formation of pus, whilst the adjoining parts are still capable of throwing out a circumscribing lymph. In this way we have seen abscesses arising from pneumonia, affecting separate lobules: thus too abscesses

are formed around foreign bodies within the lung, such as a musket-ball, and around calcareous and scrofulous tubercles, which may act as foreign bodies. In all these cases the inflammation of the most irritated parts reaches the stage of suppuration long before that of those around them; and the latter thus forms a separating wall of effused lymph, which may afterwards constitute a kind of cyst. The purulent deposits that are sometimes met with in the lungs of individuals who have died after surgical operations, wounds, or other injuries, generally present this circumscribed character.

Gangrene unconnected with suppuration is a very rare sequel of pneumonia. It may however be caused by the inhalation of noxious gases, which seem to directly destroy the vitality of the lung. The lungs of those who have died some days after being nearly asphyxiated in sewers, have been found reduced in parts to a dark brown, greenish, or livid softening, having a very fetid odour, and being probably the result of the poisonous influence of the gas on a congested lung.

The state of the tissues adjoining the vascular plexus, which is the proper seat of pneumonia, is worthy of notice. The interlobular cellular texture sometimes partakes of the general redness, and sometimes it is singularly free from it, or has it so much less, that a section of the lung is quite marbled by its lines, which are of a lighter colour. So also in the hepatised stage the interlobular septa retain their cohesion, and in more chronic cases sometimes become more thick and hard than usual. The mucous membrane of the large and middle-sized bronchi is almost always more or less inflamed, and presents the striated aspect that is also seen in the more acute forms of bronchitis. That of the smaller bronchi is often of a deeper red than in bronchitis; but from its bluish tint this would appear to arise rather from the blood under it than in it. The bronchi in the inflamed part, generally but not always, partake of the softening of the parenchyma. We have in a few instances found some of them plugged with coagulated lymph, as described by M. Reynaud and Dr. Stokes; but this by no means occurs so frequently as to strengthen the opinion of these writers, that pneumonia is generally a plastic inflammation of the minute air-tubes and cells. When this albuminous exudation does take place, M. Reynaud has shown that it may cause the obliteration of some tubes, which would lead to the dilatation of others. More commonly the air-tubes, as far as they can be traced, contain more or less of the slimy rusty mucus, like that which has been expectorated. The pleura is generally, but by no means constantly, inflamed: we have seen it free from redness, lymph, and liquid effusion, even where covering a hepatised portion of lung.

The cases of pleuro-pneumonia in which the inflammation of the pleura is so considerable as to modify the course of the parenchymatous inflammation, will be considered hereafter.

Physical signs. On applying the ear or a stethoscope to the chest of a person with incipient inflammation of the lungs, a fine crackling sound accompanying the respiratory murmur is heard generally in the inferior and posterior region of one side. In its slighter degrees it is scarcely more than an unusual loudness and roughness in the vesicular murmur, as if the air met with slight short resistances in its passage, which destroy the smoothness of the sound; but in its more pronounced degree there is a distinct crepitation, like that heard when common salt is thrown on a hot iron, or like that caused by rubbing between the finger and thumb a lock of hair near one's ear. This, which is the *crepitant rhonchus*, is first heard at the commencement of inspiration and at the end of expiration; but it soon accompanies the whole respiratory act, and in advanced degrees of the first stage it is heard only at the end of inspiration and the beginning of expiration.

The physical cause of the crepitation of pneumonia has been the subject of some difference of opinion. M. Andral considers it to be produced by the passage of air in minute bubbles through serum effused in the smallest air-tubes and vesicles, and that the fine and even character of the crepitation

depends on the fineness of the bubbles in these tubes. Thus he supposes that this crepitation differed from the mucous rhonchus only in the size of the tubes in which it is produced, and the consequent size of the bubbles in them. This opinion has been adopted by several writers, who reduce the liquid rhonchi of catarrh and the crepitant rhonchus of pneumonia to two heads, large and small crepitation. From a consideration of the pathology of pneumonia, and of the course exhibited by its physical signs, we have long been led to consider the crepitation which attends the first stage as distinct in nature from the other rhonchi. We have before had occasion to notice, that the structure and motions of the lungs tend to bring all liquids secreted in the minute tubes into those of larger size, whence they are ultimately collected in the trachea, and expelled by expectoration. Were the crepitation of pneumonia dependent on serum in the smallest tubes and cells, we ought to have proof of the presence of this serum in the other tubes by a bubbling rhonchus, if not in the expectoration also. But in most cases of the first stage of pneumonia, the chest is remarkably free from bubbling sounds in the large tubes, the rhonchi, if any, are dry, sonorous, or sibilant, and the expectoration is not serous but viscid. In fact, there is good reason to suppose that the serum which exudes from an engorged lung after death, and which Andral assumed to be the cause of the crepitation, is chiefly the result of a cadaveric change, the coagulation of the blood in the distended vessels, which does not take place during life. But what is the condition of the extreme air-tubes and cells in the first stage of peripneumony? They are narrowed and partially obstructed by the enlarged vessels which are distributed between and around them; and as the smallest tubes are narrower than the cells in which they terminate, it is easy to conceive that they are so far obstructed that the air can pass through the viscid mucus lining them only in successive minute bubbles, the bursting of which constitutes the crepitation in question. This appears to be the true view of the crepitant rhonchus; and we can thus understand that at first the crepitation must be slight and confined to the period of the respiratory movements in which the tissue is most collapsed; that as the narrowing increases, it extends to the whole movements; that subsequently the obstruction is such that it permits the crepitating passage of the air only when the lungs are most expanded, as at the end of inspiration and at the beginning of expiration; and finally, that the obstruction becomes complete, and the crepitation ceases, except perhaps still on a forced respiration.

Dr. Stokes has made the important observation, that a puerile or unusually loud sound of respiration precedes the occurrence of crepitation in pneumonia, and he considers this to denote the first stage of the inflammation. We question the propriety of calling this another stage, which probably is only a degree of the same condition which causes crepitation, the partial narrowing of the tubes, which renders the sound rougher and louder, before the crepitation begins. The sound of respiration becomes weaker as the crepitation comes on, and extends to more of the minute tubes; and it ceases when the abnormal sound occupies them all. If the disease be extensive, and the function of the lung much infringed on, the energy and frequency of the respiratory movements will be increased, and consequently the respiratory murmur on the sound side will be louder than usual, having the character of puerile respiration.

The increased matter of the congested lung will have further effects on its properties with regard to sound. It will deaden the sound on percussion, so that the affected side will give a sound rather duller than the opposite side, and different degrees of force in percussion will not materially affect this variation. But the first stage of inflammation, without liquid effusion, is insufficient to make the sound on percussion quite dull; for even in its most advanced degree, there is still enough air in the lung to give some elastic resistance to the walls of the chest, and to leave their vibrations pretty free. The motion of the affected side will be diminished in proportion as the air fails to get admission to the inflamed lung; and instead of being fixed in a state of

permanent distension, as in pleurisy, or in a state of contraction, as in spasmodic asthma, the side holds an intermediate size, measuring on full inspiration less, and on the completion of expiration more, than the sound side. The increased density of the congested lung also makes it conduct sound better than the light spongy condition of the healthy organ; so that in extensive inflammation, even during the first stage, and whilst the crepitation still continues, there may be heard some degree of the bronchial respiration and vocal resonance that are fully developed only in the stage of hepatisation.

The deposition of lymph which constitutes hepatisation of the lung, completes the obstruction of the minute tubes and cells: hence all crepitation and vesicular respiration cease, and the only sounds which reach the ear are those of the air and voice in the larger tubes, and these are transmitted by the consolidated lung with unusual loudness. The respiration is no longer heard with its prolonged murmur; but in the neighbourhood of the bronchial tubes there is a *short whiffing*, confined to parts only of the respiratory act, and often ending abruptly with a click. This bronchial whiffing is not to be heard in every case, but only when the hepatisation involves bronchial tubes of some size, and is most commonly found in the middle regions of the chest. Here too both may be heard and felt various degrees of morbid bronchophony, or vocal resonance. When the consolidation of the lung is very complete, and involves especially the central parts of the lung, the voice may be heard to sound over a space of considerable extent in the mammary, scapular, or axillary region, and so loudly, that it resembles pectoriloquy, for which it is sometimes mistaken. The bronchophony of a consolidated lung may generally be distinguished by its being extended over a considerable space, and by its being much diminished by using the stethoscope with the stopper, which is not the case with the pectoriloquy of a cavity. The vocal resonance of the tubes is also transmitted to the walls of the chest, as a vibration or fremitus which may be distinctly felt by the hand placed on the affected side, and which is much stronger than that on the healthy side. This sign, the discovery of which is due to M. Reynaud, affords an easy mode of distinction between a hepatised lung and a pleuritic effusion, for the latter generally abolishes pretty completely the vocal vibration. The dulness on percussion is now pretty complete, but it is seldom so uniform and general in the lower and middle portions of the chest as the dulness from liquid effusion. We see a reason for this on examining a hepatised lung: there are generally some lobules or portions retaining enough of air to prevent them from sinking in water: this is also sufficient to prevent the stroke sound from being uniformly and perfectly dull; and when the consolidation is perfect, it transmits the stroke of percussion to deeper-seated parts, which then yield their resonance. Thus on the left side a hepatised lung sometimes gives the tympanitic resonance of the stomach; and near the sternum, or in the mammary, axillary, or scapular regions, we may occasionally have the tubular resonance, or bottle note of the large air-tubes. It is not difficult to distinguish these sounds from that of healthy percussion; and when once we understand the cause, their presence and properties will serve rather to instruct than to confuse us. In the stage of hepatisation, the lung being nearly inexpansible, the corresponding walls of the chest are nearly motionless; and they are so in a state, neither of distension nor of contraction, without fulness of the intercostal spaces, or displacement of the viscera; and thus we have further distinctions between this case and that of pleuritic effusion. When the left lung is solidified, it transmits the sounds and impulse of the heart to an unusually wide extent of surface, instead of diminishing or displacing them as a pericardial or a pleuritic effusion does.

In the third or suppurative stage there is no change in the condition of the lung, which can modify the physical signs until the effused matter begins to liquefy; and then there is a mucous or bubbling rhonchus from the secretion into the air-tubes. There may be a change in the expectoration, either to

pus or to the liquorice-water-like liquid, described by Andral, and which seems to be a sero-mucous fluid, coloured by hæmatine in an altered state: this kind of sputum, however, we have found to succeed to pulmonary hæmorrhage more commonly than to pneumonia. More generally there is no expectoration, or such only as proceeds from the upper tubes, and therefore gives no evidence of the state of the lung. In fact, we are to infer the supervention of the third stage from the duration of the disease and the general symptoms, rather than from the physical signs. The inflammatory symptoms and fever give way to great prostration, rigors, cold sweats, a quick, weak, thready pulse, whilst the breathing is as short as ever, and the countenance exhibits the pallid, waxy, anxious, drawn, tremulous features of ebbing vitality.

The formation of abscess is less unfavourable, because it implies less extent of suppuration, and a power in the structure to circumscribe it. There are several cases recorded of recovery from pneumonia after the signs of abscess had manifested themselves. Dr. Stokes describes a case in which the cavity became obliterated by a cartilaginous septum, during a complete recovery and enjoyment of health in the pursuit of a laborious occupation for twelve months, at the end of which time the individual was again attacked with pneumonia, which proved fatal, and its effects were found to have been curiously limited by the cicatrix of the former abscess. The signs of abscess are those of a cavity communicating with the bronchial tubes, first containing liquid and air, and producing a coarse bubbling or gurgling sound on coughing or deep breathing, and, after the expectoration of pus, a cavernous or hollow respiration with pectoriloquy, or loud resonance of the voice, in some part of the chest corresponding with the affected spot. These abscesses are not uncommonly of a gangrenous character; and then there is added to the signs a putrid fetor in the matter expectorated as well as in the breath of the patient. As our limits do not permit us to enter into minute details, it may suffice to point out how the physical signs of pneumonia indicate the situation and extent of the inflammation; and, as far as relates to the diseased organ, they may guide us in the prognosis and treatment. Thus a crepitant rhonchus heard throughout a whole lung, or a considerable part of both lungs, implies extensive disease: if heard at the root of the lung, or at its apex, that is, at the scapulæ or under the clavicles, it indicates a more severe form of the disease than if heard only at the lower parts of the lung in the back. The extension of this crepitation, or its presence in new parts, is a proof of the increase of the inflammation. Its cessation, and the substitution of bronchial respiration and perfect dulness on percussion, are proofs of its advancement to the second stage. On the other hand, the return of the crepitation and resonance, where it had been replaced by bronchial respiration and dulness, announces a progress towards cure by the absorption of the obstructing lymph, and by the air again getting a straitened admission into the cells. As this process proceeds, the act of respiration accompanied by crepitation becomes longer in duration, until it equals in length that on the healthy side; but the sound is still for a time somewhat whiffing where it has been bronchial; and a crepitation of a looser, less even character, also remains after apparent cure: this is the subcrepitant rhonchus, and probably depends on the presence in the smallest bronchi of a little thin serous mucus, such as that which is seen in the expectoration, and the secretion of which seems, as in bronchitis, to assist in removing the depositions left by the inflammation. If the inflammation have proceeded to the stage of hepatisation, and particularly if it have verged on that of suppuration, in which the albuminous deposit, becoming opaque and lower in vitality, is less susceptible of absorption, the restoration of the texture of the lung to its natural light condition requires a considerable period of time, even after the apparent cure of the disease; and during this period there remain more or less of the physical signs just noticed, as well as some dulness on percussion, and

perhaps also not a full power to expand that portion of the chest. We suppose here the cure to become perfect eventually, but to require a long time; though there are other cases in which inflammation of long duration produces permanent changes in the lung, as the obliteration of some portions of the tissue and the dilatation of others: these changes happen most frequently when the inflammation is modified by a cotemporaneous effusion in the pleura, which will be noticed hereafter.

Varieties and Complications.

The form termed *typhoid pneumonia*, whether it be secondary to continued fever or primary, and originally attended by low adynamic fever in consequence of the constitution having been lowered by excesses or extreme privation, or by the depressing influence of foul air, or of an unhealthy season, differs remarkably from common pneumonia in many of its phenomena. The local symptoms are by no means prominent; and although there may be pain, cough, and very disordered breathing, the obtuse state of the mental faculties prevents attention from being drawn to these symptoms. The general functions are however greatly disordered; the pulse is very quick, small, and weak; the skin harsh, dry, and partially hot, or covered with a clammy sweat, and sometimes covered with petechiæ, or suffused with a dusky rash; the tongue is furred, brown, and dry, the alvine excretion dark and unusually offensive; and the urine is scanty, turbid, and ammoniacal. The lungs in such cases are sometimes found after death so engorged, particularly but not exclusively their posterior portions, that they sink in water: the texture is very soft and fragile, and when broken exudes a dark grumous blood: there is only an imperfect approach to hepatisation; but the texture in some parts occasionally shows a softening of a lighter colour, which seems to be an imperfect suppuration. Sometimes partial hepatisations are found, and slight films of lymph on the pleura; and in such cases it is not uncommon to find similar marks of slight recent inflammation also in the pericardium and peritoneum. We have observed this particularly in cases of external erysipelas.

The physical signs in such cases are, in the posterior parts of the chest, dulness on percussion and absence of the respiratory murmur, with an occasional short whiffing and sibilant rhonchus; but, as Dr. Stokes has remarked, there is often no crepitation, or, if it be present, it soon ceases, the obstruction becoming complete. In the anterior parts of the chest, the breathing sometimes remains quite distinct, although accompanied by sonorous and sibilant rhonchi. The signs of obstruction remain for a very long time, and the sound of respiration and percussion is much slower to return than in acute peripneumonia. Dr. Stokes has observed, that recovery in these cases is very slow, and sometimes attended by contraction of the affected side.

We are disposed to consider this affection as partaking of a congestive more than of an inflammatory character; and Dr. Hudson, in an able paper on typhoid pneumonia published in the *Dublin Medical Journal*, has taken a similar view. By some unknown cause, whether in the condition of the blood in the affected capillaries, or in both, the blood stagnates in particular viscera, generally to some degree under the influence of gravitation; and the functions of the organs are proportionately impeded or disturbed. There is at the same time more or less irritation, which may give to the congestion the semblance of an inflammation; but its products are imperfect and irregular; and neither by the free effusion of plastic lymph, nor by the formation of pus, is a true inflammatory orgasm manifested. We can see why this condition in the lung may be unaccompanied by the usual signs of the gradual formation of a crepitating obstruction, because the engorgement is at once produced, and renders a great part of the tissue impervious to air. But this degree of congestion, if it occupy the middle parts of the lung, may give bronchophony and bronchial respiration.

The *complication of pneumonia with bronchitis* is very common: in fact, in almost every case of pneumonia the bronchi are also inflamed; but sometimes the bronchial affection is primary and extensive, and inflammation of the parenchyma is superadded. In such cases, if the bronchial secretion be considerable, the noisy rhonchi which it occasions mask the physical signs of peripneumony; and in consequence of the depressing influence of the same cause on the respiratory function, the general symptoms also are more than usually obscure. But on listening particularly at the end of inspiration on the posterior and inferior regions of the chest, which correspond with the lower margins of the lobes, the fine crepitation may generally be heard if pneumonia is present. The rusty tinge of parts of the sputa, and, as the disease proceeds, the greater dulness on percussion, will also become apparent when the inflammation has extended to the pulmonary plexus of vessels. Of the forms of bronchitis that occasionally pass into pneumonia, those of epidemic influenza, hooping-cough, and those accompanying fevers and diseases of the heart, may be mentioned as presenting this combination.

Pleuro-pneumonia. The effects of a concomitant pleurisy on the pathology and signs of pneumonia are highly deserving of notice. Whenever the inflammation extends from the lung to the pleura, it may be supposed to increase the serous secretion, and perhaps lead to the effusion of lymph; but when the pulmonary inflammation has existed first, and become extensive, these pleuritic products are commonly of small amount. When the inflammation has attacked the parenchyma and the investing membrane nearly to an equal degree, constituting the disease called by Laennec *pleuro-pneumonia*, the effusion in the pleura by its pressure modifies the effects of the inflammation in the lung. The lung is found after death consolidated, but more tough and red than in the state of ordinary hepatisation, and totally destitute of the granular aspect. It much resembles the substance of some muscles; hence Laennec termed this condition *carnification*. It seems to exhibit the more essential part of inflammation of the lung; the sequel or effect, effusion into the coats of the air-cells, which constitutes granulation, having been prevented by the pressure of the external liquid effusion. This combination is therefore also slower in progress than simple pneumonia: the degree of the inflammation as well as the quantity of its product is restrained by the external pressure, and it scarcely, if ever, proceeds beyond the second stage. But this slower rate of progress tends to make its effects also more permanent. If false membranes are formed on the pleura, they have time to become firmly organised, and to bind down the lung in its compressed state; and the lymph effused in the tissue itself, scanty though it be in comparison with that of a hepatised lung, may become the means of adhesion and permanent contraction of the compressed cells and finer tubes, and of consequent obliteration of more or less of the proper tissue of the lung. There is an ulterior result which has hitherto escaped the attention of pathological writers. When the liquid effusion is removed by absorption, and the chest becomes again capable of expansion, what will supply the place of the obliterated cells? The chest remains to a certain degree contracted as after pleurisy; but the atmospheric pressure will also at each inspiration be brought to act on the larger air-tubes that are yet unobstructed; the air can no longer reach the smaller branches or cells of these tubes, so it must dilate the tubes, and make their increased size in some degree compensate for their defective terminations. Pleuro-pneumonia is then, as we have before had occasion to remark, a cause of dilatation of the bronchi. We have met with several examples of this kind; and on referring to the records of other cases of extensive dilatation of the bronchi, we have found several in which the symptoms are described to have originated in an inflammatory attack like pleuro-pneumonia; and probably all those cases in which the dilatation affects one side only, and in which there is much consolidation of the lung with some contraction of the chest, originate in this way.

The general symptoms of pleuro-pneumonia are not materially different

from those of the more simple inflammations, but they are often less severe, and sometimes very obscure. The physical signs are a combination of those of pneumonia, and of liquid effusion in the pleura. At first there is crepitation; but this becomes indistinct, as the lung is pushed aside by the liquid; whilst the dulness on percussion is much more marked than in pneumonia, at least in the lower parts of the affected side. In the central regions of the chest, bronchial respiration and bronchophony are soon produced by the condensed lung being pushed against the walls; and if a thin layer of liquid intervene, the bronchophony acquires a loud buzzing accompaniment, like the voice in the performance of *Punch*: in fact, the sound seems to consist of two voices, which probably arises from some of the vibrations being modified into a buzzing or bleating, by passing through the thin layer of liquid, whilst other vibrations pass unchanged. The vocal resonance is generally louder in pleuro-pneumonia than in either pleurisy or simple pneumonia; which probably arises from the chief tubes being pressed more closely against the walls of the chest, with complete condensation of the vesicular structure. The same circumstance sometimes gives the amphoric or tracheal sound on percussion in the mammary region, which forms a singular contrast to the dulness of other parts. We have also found the respiration quite tracheal in this spot, and the resonance of the voice quite as loud as that of caverns. These phenomena become more remarkable in cases which from inefficient early treatment become chronic, the consolidation of the lung remaining permanent; for, as the liquid is absorbed, the bronchi become dilated, and exhibit the phenomena of pectoriloquy, cavernous breathing, &c. as described under *Dilatation of the Bronchi.*

Pneumonia frequently attacks patients in both the early and advanced stages of *tuberculous disease.* Sometimes it is partial and readily yields to treatment: but not a few fall victims to it when it is more general, and this sometimes in the absence of symptoms sufficient to distinguish it from the pre-existing disease. Again, it is not unusual to find miliary tubercles in the lungs of those in whom the ordinary treatment for pneumonia had proved unavailing.

The pneumonia which sometimes supervenes in continued fevers, small-pox, erysipelas, scarlatina, and in various chronic diseases during the prevalence of epidemic peripneumonia, is generally of a congestive or typhoid kind, and often appears to be the immediate cause of death. In many such cases the symptoms of the pulmonary affection are often very obscure.

The bronchial affection of *measles* sometimes passes into pneumonia, especially when the eruption disappears suddenly with continuance of fever; here the symptoms are generally pretty evident. A congestive and latent inflammation of the lungs is sometimes a complication of *endemic and periodic fevers;* and the reaction after the collapsed stage of *malignant cholera* and *asphyxia* is peculiarly apt to fall on the lungs.

Several surgical writers have noticed the occurrence of pneumonia after severe *injuries* and *surgical operations.* It is often latent, and may declare itself only a short time before death, by the oppressed breathing and rattle in the tubes. In some instances of this sort the lungs are found only in the first stage of inflammation; in others there are circumscribed hepatisations; and not a few present the singular lesion of purulent deposits in the pulmonary tissue. These deposits are always well-circumscribed, the tissue around being sometimes inflamed, sometimes healthy; they are at first of a red colour with a brighter margin, and interspersed with pink, drab, or yellow spots, the latter appear to be sections of the vessels, and on being pressed exude pus. In a more advanced state more of this lighter colour is seen, and gives the appearance of purulent infiltration, whilst on the margin of the deposit a distinct coat of lymph can be traced, circumscribing the diseased part. In a few cases, the process of suppuration has been found completed in the formation of an abscess. These fatal sequels of injuries are to be considered as the result of a diseased state of the blood rather than of true pneumonia. Pus is probably formed in the blood

or elsewhere, and deposited in the lungs on account of their great vascularity, where it is circumscribed by secondary inflammation; sometimes it is deposited in other organs.

Diagnosis. Under this head we need only pass in review some of the more distinctive signs of pneumonia, and the chief points by which it may be distinguished from the diseases which most resemble it. The general symptoms, when all grouped together, often sufficiently characterise the disease, but their occurrence and their degree are very uncertain, and by no means constantly announce its amount or even its presence. Of the single symptoms the expectoration is certainly the most characteristic. The rusty tinge is considered by Andral and others to be quite pathognomonic of pneumonia; but we have seen it in various degrees communicated to the bronchial mucus by congestions which are not inflammatory, as in bronchitis supervening on organic diseases of the heart, causing great pulmonary congestion, and also after pulmonary hæmorrhage. It sometimes happens too that there is no expectoration, especially at the onset of the disease, and in the case of young children it is seldom brought to view. The crepitant rhonchus, in conjunction with the general symptoms, may be more safely depended on, for its presence is more constant, and its extent and progress well represent the amount and state of the disease. Increasing dulness with bronchial respiration and sound of the voice equally mark the transition of pneumonia to the second stage. From pleurisy, pneumonia may be distinguished in the first stage chiefly by the crepitation and expectoration; in the second, by the bronchophony and vocal vibration sensible to the hand, and by the absence of signs of displacement of the walls or organs bounding the lungs, and of any change by posture in the sound of percussion. From bronchitis, pneumonia may commonly be distinguished by the crepitation, which is finer and more equal than that of bronchitis, by the rusty tinge of the sputa, and, as the disease advances, by the dulness on percussion, bronchophony, and bronchial respiration. The skin is hotter and less livid than in severe bronchitis; neither is the cough or the dyspnœa generally so urgent. From pulmonary apoplexy, or hæmorrhagic congestion, it may be known by its febrile commencement and course, by the absence of any real hæmoptysis, and by the crepitation and dulness on percussion being progressive, and rarely so circumscribed as in pulmonary apoplexy. Inflammation is, however, very commonly engrafted on pulmonary apoplexy. Œdema of the lungs and tuberculous disease in their physical signs may resemble pneumonia, but their history and general symptoms will in most instances sufficiently distinguish them.

Prognosis. Pneumonia must at all times be viewed as a serious disease, and the prognosis even in favourable cases should be given with caution, as cases which are at first slight may take an unfavourable turn, and in progress towards recovery, as long as the disease lasts, there is a chance of relapse, which may throw the patient into new danger. The circumstances which chiefly affect the prognosis are the stage of the inflammation, its seat, its extent, its complication with other affections, and the state of the general health and strength. As this disease in its progress tends to the disorganisation of the lung, so its continuance increases its danger; hence the prognosis is more unfavourable if hepatisation has taken place; and still more so, if the signs seem to indicate the supervention of the third stage. The duration of the stages varies very much in different cases, according to the violence of the inflammation, the age of the subject, and the effects of remedies. Laennec states the average duration of the first stage (engorgement), at from twelve hours to three days; the second (hepatisation), from one to three days; the suppurative from two to six: remedies which retard the progress of the disease prolong the period of the two first stages. We think even these statements more precise than the subject will admit of, for the duration of the first two stages presents a remarkable variety in different cases. In children, and in some epidemics, also in adults, the first stage may last for more than a week, without the production of hepatisation. On the other hand, in aged and debilitated subjects, the inflammation may speedily reach the stage of suppuration.

Laennec describes this to have taken place in some instances within twenty-four hours. Recovery may take place from every degree of pneumonia; but the chances of this are very small, when it is probable that suppuration has taken place. Even simple hepatisation requires time and favourable circumstances to effect the absorption of the effusion. Until there is evidence of the advancement of this process of absorption, as well as improvement in the general symptoms, the prognosis must remain doubtful; for inflammation may readily return in the lung around the hepatised portions. The supervention of a gangrenous odour in the expectoration is a formidable event; but not a hopeless one, for a few cases in our own experience, and several on record, have occurred in which recovery took place.

The extent of the inflammation greatly affects the danger of the case. A double pneumonia affecting both lungs at the same time is frequently fatal even in the first stage; and whenever the whole of one lung is involved, there is great peril of an unfavourable issue. Inflammations attacking the upper lobes and root of the lungs are more fatal than those confined to the lower lobes; a result which may be the consequence of the former containing bloodvessels of larger size.

The complication of pneumonia with other diseases generally increases its danger. It is often fatal when supervening on the different forms of fevers, on gastro-enteric, bronchial, pericardial or peritoneal, inflammations, and in these cases it is very apt to be latent. Pleurisy on the same side may diminish the intensity of the pulmonary inflammation, but if it attack the opposite side, it adds to the oppression and danger. Pneumonia is more than usually fatal during pregnancy and in the puerperal state, and at the extremes of age, especially in weakly infants, in cachectic old people, and in those exhausted by habitual excesses. The fatality is much greater among the lower classes than among those well and regularly fed and clothed. Besides the preceding circumstances, the general health and vigour of the subject, the severity of the chief symptoms which indicate the state of the vital functions, especially the dyspnœa, the pulse, the expectoration, and the mental faculties, and the influence of the remedial measures which have been employed, all must be taken into account in estimating the prognosis in particular cases.

Causes. It is well worthy of remark, that bronchitis and pleurisy affect vessels which freely communicate with those of the parenchyma: but although they do occasionally extend to the latter vessels, and thus excite peripneumonic inflammation, yet they are generally quite distinct from it both in their present course and in their ulterior effects, and require a distinction in treatment which should be borne in mind. We find an explanation of this difference in the peculiar character and importance of the pulmonary bloodvessels; in their great number and capacity; in the large proportion which they bear to the other solids of the lung; and in their great liability to congestive distension. This extensive and important plexus of vessels, through which the whole blood of the body passes, is, as we have before seen, peculiarly liable to distension from any cause which may disorder the function of the heart or lungs. Thus all those causes which tend to induce asphyxia, produce also that congestion of the pulmonary vessels which, added to irritative reaction, may constitute inflammation. Thus we see that various causes which disturb greatly the balance of the circulation, particularly by deranging the passage of the blood through the lungs, may become causes of pneumonic inflammation. Of these the most remarkable are, long-continued exposure to cold, asphyxiating poisons, congestive fevers, violent exertion, diseases of the heart, bronchitis, asthma, wounds, tubercles, and foreign bodies in the lungs, and the moribund state. Pneumonia is so frequently complicated with hooping-cough, measles, and small-pox in children, that it forms one of the chief sources of the danger in these diseases. The same remark applies to many forms of continued fever in adults. In common with other inflammations, it may be occasioned by the suppression of habitual discharges. The inflammations of gout, rheumatism, and cutaneous

diseases, are rarely transferred to the lungs. Cold is unquestionably the most common cause: this is especially shown by its prevailing almost exclusively in the cold season, and chiefly in March and April, during the continuance of cold winds. The epidemic occurrence of the disease has been repeatedly noticed. Laennec conjectures that the epidemic cause is often not merely change of temperature but deleterious miasms in the air, which exert a specific operation on the lung, as the poisons of the rattlesnake and of some fungi are said to do. Huxham observed that, during an epidemic, bronchitis prevailed in low damp places, and pneumonia and pleurisy on more elevated situations. Although met with chiefly in cold countries, milder climates are not free; it occurs to a great extent in the south of France and Italy, where however the winds cause great and sudden changes of temperature. Its frequent occurrence in the neighbourhood of Vesuvius may perhaps be attributed to the noxious exhalations which prevail there.

Treatment. The indications of treatment in pneumonia vary according to its stages. In the first stage, the chief object is to remove the inflammatory irritation and congestion from the pulmonary vessels; in the second there is another indication, to promote the removal of the interstitial effusion, the product of the inflammation: even in this stage, when the strength fails, and more particularly in the third stage, it is necessary as far as possible to support the functions which are oppressed by the extent of the organic lesion induced. Particular symptoms may also give occasion to other indications in every stage. We shall shortly notice the principles which may guide us in the use of remedies to fulfil these several indications, and then advert to the application of the treatment in the different forms and complications of the disease.

Treatment of the first stage. Distension of the great pulmonary plexus of bloodvessels being the first condition of pneumonia, from whatever course it may proceed, we may hope in the early stage of the disease to relieve it by bloodletting, as well as to prevent the process of reaction which renders it essentially inflammatory; and in some instances, where the local signs announce the presence of the disease in its first stage, and the general symptoms prove it to be of a sthenic character, the free loss of blood by one venesection will arrest the progress of the disease. But when the vessels have been so long distended and become the seat of fixed irritation so much, that the mere removal of pressure from the sanguiferous system at large will not enable them to recover their usual size, a single bloodletting may not be sufficient; it must be repeated as often as the strength will bear it, and other remedies must be used, which also have the power to counteract the inflammatory irritation. Of these the most important are tartarised antimony and mercury. M. Louis has inferred from an application of numerical calculation to certain cases of pneumonia, that early bloodletting never arrests the disease, and that it only shortens its duration by four or five days. It is clear however that many of the cases classed by Louis as pneumonia, were instances of the asthenic or typhoid disease; an affection certainly in treatment, if not in pathology, differing widely from sthenic or acute pneumonia. We suspect also that a great prevalence of similar cases, and the absence of the fully sthenic character among the pneumonic patients of the Meath Hospital, have led Dr. Stokes to conclude that one, or at most two, bleedings will be sufficient, and that local bloodletting is the principal remedy.

The utility of tartarised antimony in emetic and nauseating doses in pectoral inflammations had long been recognised, but its power of subduing acute inflammation, independent of its emetic, nauseating, or diaphoretic effects, was first pointed out by Dr. Marryatt of Bristol, and further developed by Rasori of Genoa. Its peculiar efficacy in pneumonia was especially shown by Laennec, who considered its value to be above that of bloodletting. Chiefly to the efficacy of this remedy he ascribes the uncommonly small mortality of only two in fifty-seven cases which he states to have been the result of his practice of late years. He gave the medicine in doses of from one to two and a half grains in three ounces of sweetened weak infusion of orange leaf, withholding

the medicine after the sixth dose, or persevering in it according to the severity of the symptoms. This remedy has now been successfully employed by many practitioners at home and abroad, and its efficacy seems pretty well established, but not to the degree claimed by Laennec. In this country it is considered as subsidiary to bloodletting; and it has not been found useful to give the large doses which Laennec sometimes employed. From half a grain to two grains in an ounce and a half of some agreeably flavoured liquid may be given every second, third, or fourth hour, according to the severity of the case. The first dose commonly causes vomiting, but this generally ceases after the second or third, and if it should not, two or three drops of the diluted hydrocyanic acid will generally stop it. If it causes purging, it may be useful to combine a small quantity of opium with the antimony. The mode in which tartar-emetic acts is not well understood. Its antiphlogistic power does not essentially depend on its nauseating, emetic, purgative, or diaphoretic effects; for although these are occasionally induced by it, yet it is often quite as successful where none of these effects has been produced. It appears to be directly antiphlogistic by a specific action on the inflamed vessels; this, although not an explanation, is as intelligible as the specific action of remedies on the vessels of the intestinal canal, the liver, or the kidneys. Some pathologists, particularly the followers of Broussais, suppose tartar-emetic to act as a kind of internal blister, inflaming and causing pustules on the gastric mucous membrane; and Andral cites two or three cases in which such a condition was found after death. But these are rare instances; and among very many in which we have seen it used we have never met with any in which, with due discretion in its administration, any symptoms of permanent gastric irritation have resulted from its use. In the wards of Laennec we have seen patients taking twenty grains daily, not only without experiencing sickness, pain, or diarrhœa, but even without losing either appetite for food or the power to digest it. Such a quantity is however by no means necessary; we have never found it useful to exceed ten or twelve grains in the day, and a smaller quantity often suffices. After bloodletting judiciously employed, this remedy has appeared to us the best for reducing the inflammation in its first stage, if properly administered: it will often prevent the necessity of further loss of blood; but as Drs. Graves and Stokes remark, its use must be continued for some time after the apparent amelioration of the general symptoms; and it must not supersede further bleeding should the symptoms indicate the propriety of this measure.

The exhibition of mercury and opium as a remedy in inflammations was first practised in this country by Dr. Hamilton of Lyme Regis: it is now very generally employed as an antiphlogistic, after and together with bloodletting. The efficacy of mercury depends in great measure on its being given to such an extent as to affect the gums; but its beneficial operation is often apparent before this effect is produced, and in some instances, as in children, without its occurring at all. But there is seldom that speedy improvement, which is often apparent after the first doses of tartar-emetic: the operation of mercury is more gradual, and as might be expected, when once the system is under its influence, the effect is more permanent. It is therefore more adapted to the less active forms of the disease and to the second stage. Calomel is the form of mercury generally preferred in acute inflammations; and as its purgative effect is not an object, it is necessary to combine it with opium, except the first dose, with which it may be useful to clear the intestinal canal. With this view, from five to twenty grains of calomel may be given alone after the first bleeding; and subsequent doses of from five to twelve grains with a grain or a grain and a half of opium, and the same of ipecacuanha three or four times in the day until the gums be affected, will generally be found suitable for the more sthenic cases. Smaller doses more frequently repeated answer better in less acute cases, and those with more semblance of continued fever. Where there is a tendency to diarrhœa, the Hydrarg. c. Cretâ in larger doses may be substituted for calomel. In apportioning the doses of mercury and opium we

must be guided by the features of the individual case. The opium acts as an anodyne in allaying the pain and cough, and as a sedative in quieting that nervous irritation which often follows free bloodletting and the use of mercury, whilst the injurious stimulant and astringent effect of opium is counteracted by the mercury and previous bloodletting. But the chief action of the mercury appears to be of that specific kind which enables it to remove the product effused by inflammation, as we see visibly illustrated in the case of iritis.

It may be supposed that in an inflammation so deep seated as pneumonia local bloodletting is of but inferior efficacy, and is useful only as an aid to venesection, when from the local pain there seems to be inflammation of the pleura: or after general bleeding has been carried to a full extent, a decided impression on the symptoms may be kept up by local bleeding together with tartar-emetic or mercury. Counter-irritation in the early stage during the prevalence of fever causes too much excitement, but it becomes of use when the pulse has been reduced; and in typhoid cases blisters may be used from the commencement. They also much promote the dispersion of the congestion, which even the first stage of inflammation leaves in the lung. Little good is to be anticipated from purgatives, diuretics, diaphoretics, or sedatives until the violence of the inflammation has been reduced by bloodletting; then each of these kinds of remedies may be indicated by the symptoms. The same observation will also apply to expectorants in all but the slighter cases, in which there is obviously a natural tendency to relief by expectoration: in such instances the decoction of senega with tincture of squills and solution of acetate of ammonia or an alkali may considerably promote this discharge.

Treatment of the second stage. When the physical signs announce that the lung has already become extensively consolidated, with little remains of crepitation, the treatment must be conducted on a different principle from that of the first stage. Solid matter is already effused, and no amount of bloodletting or other means of depressing the circulation can remove this. Their utility is therefore much more limited, and is chiefly confined to the removal of any increase of irritation or congestion, or to reduce the bulk of the blood to the capacity of the abridged state of the respiratory organs. The most powerful remedies are those which modify the action of the diseased vessels, and promote the absorption and elimination of the effused matter. Mercury is the most efficacious of these, and calomel the most convenient form. Its combination with opium assists its effect, and tends to allay the pain and cough which may be present, as well as the nervous irritation which is very apt to occur after depletion has been carried to a full extent.

As the consolidated state of the lung often remains for a long time, even after the inflammatory action has been subdued, a great variety of remedies, according to the state of the general symptoms, may become necessary in this stage. Thus, besides the antiphlogistic means before mentioned, some of which must be used as long as crepitation is heard in any part of the lung, more aid may now be derived from external counter-irritation by blisters or tartar-emetic, and from expectorant mixtures containing an alkali. According to the state of the pulse, heat of skin, cough, pain, &c., these mixtures may be saline, with digitalis, squill, and liquor potassæ, or in a less sthenic state decoction of senega, camphor, squill, &c. with acetate, muriate, or even carbonate of ammonia. We have found these alkaline salines exert considerable influence in promoting expectoration and in dispersing the solid recent product of inflammation in the lung. If such measures with external counter-irritation be neglected, because the general symptoms are relieved, there is great risk that the hepatised portions of lung may become the seat of chronic disease or that acute inflammation may be re-excited around it, and there is more danger of these evil consequences in scrofulous constitutions and where the inflammation has been of a less acute character. When the fever has entirely subsided, and the symptoms of local irritation are inconsiderable, although the physical signs show that a portion of the lung remains consolidated, a combination of liquor

potassæ and hydriodate of potash with decoction of senega or sarsaparilla will sometimes assist to restore the healthy state of the lung.

Treatment of the third stage. When from the supervention of rigors, cold sweats, feeble, very rapid, or irregular pulse or other signs of prostration, it is probable that suppuration has commenced in the lung, the utility of antiphlogistics wholly ceases, and if any thing may be yet done by medicine, which can rarely be hoped, it is by remedies of a stimulant kind, especially those which may tend to assist the respiratory forces to expectorate the matter which accumulates in the tubes; such as carbonate of ammonia, tincture of lobelia, ether, and camphor, in decoction of senega, or wine, or hot spirits and water. Nor are such remedies to be restricted to the third stage; they may be indicated whenever the vital powers fail, and when the sthenic character of inflammation has entirely ceded to its ulterior and opposite result—depression from incapacity of the disabled organ. Under all such circumstances, the general symptoms are better guides to practice than the physical signs, for the whole frame then suffers as well as the function of the lung, and requires more immediate attention.

When from the fetid odour of the breath and expectoration, it is probable that a portion of the lung has lost its vitality, the treatment must still be guided by the general symptoms. If these betoken the persistance of active inflammation, the gangrene is probably circumscribed, and antiphlogistic remedies must still be used; but if they have given way to adynamic symptoms, the use of stimulants is indicated even more imperatively than in the suppurative stage. Dr. Stokes gave the chloride of lime combined with opium in a case of gangrene of the lung, with a temporary effect of removing the fœtor of the breath and sputa, and of greatly improving the constitutional symptoms. We have used the nitro-muriatic acid with the same view, to counteract the septic influence of the putrescent matter in the system, and apparently with good effect. In one instance the patient recovered, although the physical signs had showed the existence of a large cavity in the posterior lobe of the right lung with great fœtor of the breath and expectoration. Laennec recommends bark or sulphate of quinine in large doses in gangrene of the lung, even when accompanied by extensive hepatisation.

We now proceed to point out the application of the treatment to particular cases. Where the disease is at all severe, the treatment with tartar-emetic or with calomel and opium should be commenced immediately after the first bleeding, and continued uninterruptedly until an impression is produced on the disease. It is not safe however with either of these remedies to lay aside bloodletting: if obvious relief do not ensue in the course of five or six hours after the first full bleeding, this measure must be repeated either generally or locally, as the strength may bear it, and again on the next day if necessary.

In the more acute cases, uncomplicated with gastric disease, we have found advantage from combining the mercurial with the antimonial treatment, by giving a pill containing from 5 to 10 gr. of calomel with from ½ to 1½ gr. of opium every four, six, or eight hours, and in the intervals the tartar-emetic draught, and where the tolerance is soon established the effect of this combination is very powerful. If the bowels be too much acted on, the Hydr. c. Creta in double quantity may be substituted for the calomel. When an improvement takes place in the symptoms, the mercury may be given at night only, or omitted altogether, and the case left to tartar-emetic and whatever depletion or counter-irritation may be required.

If the attack of pneumonia be very recent, and accompanied by a pleuritic stitch in the side, or catch in the breathing, a full dose of opium after a large bleeding, as recommended by the late Dr. Armstrong, will sometimes succeed in cutting short the disease. This plan can be adopted only where the bleeding has been so copious as to produce a great impression on the heart's action, almost if not quite amounting to syncope. The dose of opium should be large; two or three grains of the aqueous extract, or, if the pain and tendency to re-

action be urgent, from thirty to sixty minims of the liquor opii sedativus, or of Squire's tincture of bi-meconate of morphia, will generally succeed best. Even in this case we think it advisable to give from six to twelve grains of calomel soon after the opium: it does not interfere with the sedative operation of the latter, and by preserving the balance of the secretions it prevents those functional derangements which sometimes follow the use of opium even in this way.

If the disease have to any extent passed into the second stage, and even if the first have lasted twenty-four hours, there can be little hope of subduing it by opium; and we must then trust to the other remedies. Blisters can seldom be used with advantage until all fulness and hardness of the pulse and heat of skin have subsided; and either these symptoms or the continuance of a fixed pain would counterindicate the use of senega and other mild tonics and expectorants, which are otherwise useful in the decline of the inflammation.

The great fatality of pneumonia among children renders it necessary that its treatment should be directed with the greatest promptitude and care. This fatality does not arise so much from the course of the inflammation, as this is less rapid than in adults, but from the latency of the local symptoms, and the tendency of the disease in a disguised form to pass the period in which remedies are most effectual. Hence many infantile cases of pneumonia, particularly among the lower classes, are in an asthenic state before we are summoned to treat them; the depressing influence of the injured function of the lungs having already removed the sthenic character of the disease. This shows the importance of physical examination of the chest in all the febrile affections of children, in order that if any crepitant rhonchus be discovered, the fit remedies may be promptly used. In this early stage bloodletting is very efficacious; but when used after the disease has lasted for several days, it sometimes produces convulsions and sinking without relieving the breathing. The same observation applies to tartar-emetic, which, if used together with bloodletting soon after the commencement, will seldom fail to subdue infantile pneumonia uncomplicated with tubercle. Mercury acts in children more on the bowels than on the gums, causing green feculent evacuations: it is of great efficacy, and our chief remedy when bloodletting is no longer borne. In children there is little risk of arresting the expectoration by purgatives: it would seem that as it is a less natural process in early life, expectoration is of less consequence than in the adult. Counter-irritation with mild tartar-emetic ointment or solution is of great benefit in the after stages of pulmonary inflammation in children, and should especially be persevered in when there is any sign of a phthisical tendency.

In aged persons the disease being generally of an adynamic or typhoid type, is often intractable in consequence of the great debility which accompanies it. Advanced age alone however should not restrain us from bloodletting where the state of the breathing, heat of skin, and the pulse seem to require it. Frank bled an octogenarian with pneumonia nine times with a good result. Such cases are however exceptions; for the period in which bloodletting is useful in old people is short, and often restricted by a complication with humid bronchitis. Expectoration is here an important process, and may sometimes be aided by some of the remedies just mentioned, with the mercurial or tartar-emetic treatment and blisters at an earlier period than usual.

The typhoid form of pneumonia requires a treatment considerably modified. Bloodletting not only is very ill borne, but it appears to have very little influence on the disease. There seems to be in the pulmonary vessels a loss of tension or tonicity, and we might empty the great bloodvessels, and stop the heart's action before the congestion of the lungs would be relieved and their vessels enabled to contract. Besides, the depressing influence of typhoid diseases renders any loss of blood hazardous, and local depletion is the utmost that can be attempted. Considerable advantage may under these circumstances be derived from dry cupping on the chest; which for the time tends more effectually than even bloodletting to draw the fluids from the congested organs whilst it does not drain the blood from the system. Blisters and sinapisms

also may give relief in slight cases, but their effect is limited, where, as it commonly happens, the whole posterior part of both lungs are congested with blood which is itself probably in a morbid state. The principal remedy in this form of pneumonia (if pneumonia it can properly be called) is mercury, which may be combined with opium and saline medicines, and, in case of great prevalence of the adynamic symptoms, with stimulants and tonics, such as wine, ammonia, and bark. Medicine has often very little power in these cases; but as far as our experience goes, stimulants judiciously given when the heart's action, as examined by the stethoscope, is feeble, and diminished or withdrawn as soon as it becomes increased, and the pulse sharp or hard, have appeared to relieve the pulmonary affection as well as to support the strength. Musk is highly recommended by M. Recamier in typhoid pneumonia: he gives it in doses of from twenty-four to thirty grains, with an effect which he almost considers specific.

It may be questioned whether the affection called intermittent peripneumony, and said to have been cured by bark, is really an inflammation; it is more probable that it consists of a simple congestion of the lung, just as similar congestions are more familiarly known to take place in the spleen and liver, and which, when recent, give way to bark or arsenic, not to bloodletting. We have stated that typhoid pneumonia, and that attending continued fevers, are more properly to be viewed as congestive than inflammatory; at the same time it must not be forgotten that congestion may by a process of reaction be converted into acute inflammation with all its products, and otherwise, unless soon removed, frequently tends to produce some chronic change of structure.

The complication of pneumonia with bronchitis is generally best treated by moderate bloodletting followed by the antimonial treatment. Blisters and expectorant mixtures are of more avail than in simple pneumonia, the disease often terminating by free expectoration.

In pleuro-pneumonia local as well as general bloodletting should be practised fre ly; and after the more acute stage has subsided under the influence of these and of antimony, if the buzzing bronchophony and dulness on percussion still continue, the side should be blistered repeatedly, and a mild course of mercury prescribed to promote the removal of the fluid and the interstitial lymph which might lead to partial obliteration of the tissue of the lung.

In pneumonia supervening on hooping-cough and influenza, it is sometimes a chief indication to give sedatives to allay the cough, which appears often to have a considerable share in producing the parenchymatous inflammation: with this view the sedatives recommended for hooping-cough should be combined with the usual treatment.

Where an inflammatory state of the mucous or serous membranes of the alimentary canal accompanies pneumonia, it is of great moment that in the treatment these complications should be considered, as they may render some of the ordinary remedies injurious. Leeches followed by poultices should be applied to the abdomen, and the milder forms of mercury with Dover's powder exhibited, assisted by laxative enemata or very gentle aperients.

Diet and regimen. In ordinary cases of pneumonia the diet should be strictly antiphlogistic, and during the early stages confined to thin mucilaginous or farinaceous liquids. Even these should not be used in excess, for in large quantity any liquid may first distend the stomach and then increase the mass of the blood, and in both ways augment the dyspnœa. In those addicted to a very free use of fermented or spirituous liquors, as well as in typhoid pneumonia in general, it is sometimes necessary to continue a certain quantity of these stimuli. M. Chomel found a considerable diminution in the great mortality of such cases, on adopting this plan. In gangrene or extensive suppuration indicated by fœtor and copious purulent expectoration with great prostration of strength, it also becomes necessary to give beef tea, animal jellies, and wine; but great circumspection must be used to withdraw them in case of fresh excitement. It is equally necessary to be very cautious with regard to the im-

provement of the patient's diet during convalescence, by adopting gradual transitions, and by properly regulating the alvine function.

Pneumonic patients should be kept in an airy room without draught, of moderate temperature (about 60°). It is of considerable importance in the more severe cases to raise the chest above the level of the body by a bed chair: this facilitates breathing and expectoration, and prevents the too free gravitation of the blood to the lungs. In prolonged cases, especially those of a typhoid kind, it is also proper to vary the posture from side to side, and to lying on the face when the patient cannot sit, several times in the day, to prevent the *hypostatic* congestion. This is recommended by M. Gerdy and Dr. Stokes.

Chronic Pneumonia.

As we have seen with regard to pleurisy, so also in pneumonia, the inflammatory action may not entirely cease with the effusion of lymph, although it do not lead to the third or suppurative stage. When acute inflammation is extensive, and the effusion of lymph is not removed by absorption, the disease generally proves fatal before there is time for further change; but in circumscribed peripneumonies, or in small parts of more extensive hepatisation, a chronic inflammation sometimes goes on, and produces that kind of tough induration which is the general result of chronic inflammation in a parenchymatous structure. Thus in the lungs of those who have suffered from long and repeated attacks of inflammation of the chest, even where there are no tubercles, we not unfrequently meet with portions of the tissue that are dense, almost destitute of air and of liquid, tough, and sometimes almost cartilaginous. Their colour varies from a dark dingy red to different lighter shades of reddish brown and buff, sometimes rendered grey by a mixture of the black pulmonary matter. Their aspect also is varied, like that of acute hepatisation, by the tissues that are chiefly affected being sometimes granular or oolitic (as Laennec has stated) from the especial thickening of individual vesicles; in other cases streaked or veined, from the hypertrophy of the interlobular septa and cellular tissue around the large vessels; in others more uniform and of a darker colour, from the pulmonary plexus of vessels being the chief seat of the alteration, and the colouring matter of the blood entering largely into the deposition. In this last variety the cellular tissue between the lobules is sometimes thickened to the amount of several lines, and is of a light drab or grey colour, like that of miliary granulations, and like them has almost the density of cartilage. These changes, which thus occur as the sequel of acute pneumonia, are also frequently met with complicated with those states of the lung which are called tuberculous; and a considerable portion of the consolidation that is met with in phthisical lungs often presents the same anatomical characters as these chronic hepatisations which supervene on acute pneumonia imperfectly subdued. These will be further noticed under Phthisis. We have also several times met with these chronic consolidations in the lungs of those who have long suffered from extensive organic disease of the heart, where the circulation of the lungs was perpetually impeded by the structural lesions of that organ; it is probable that the same mechanical congestion from this cause which sometimes leads to effusion of blood in the tissue, constituting pulmonary apoplexy, may if long continued terminate in effusion of lymph, and obliteration and consolidation of the pulmonary texture. This condition of the lung is sometimes coupled with an irregular dilatation of the air cells; and on examination after death the organ presents a knobby surface, and feels nodulated, where the consolidation occupies lobules or parts. There seems to be reason for ascribing also to a minor extent of chronic inflammation of the parenchyma, that increased density and rigidity of the pulmonary tissue, without entire consolidation, which is often found in the lungs of those who have long suffered from dyspnœa, whether from bronchial or cardiac disease.

The *signs* of chronic pneumonia are those of circumscribed consolidation and

obstruction of the pulmonary tissue, which continue long after the urgent symptoms of the acute disease have subsided. The dyspnœa has become less oppressive, but it is still felt on exertion; the fever has been reduced, but there is still some quickness of pulse and heat of skin towards night; there is still some cough; and although there may be improvement in the appearance and strength, it is not progressive, the patient remaining with his organs and functions abridged: there is still partial dulness on percussion, with some bronchial respiration and vocal resonance in the seat of the late inflammation. If in this state the patient neglect the means which may most conduce to the restoration of his general health, as well as to the removal of these remains of local disease, the indurated portions of lung may either prove centres of fresh inflammation, or they may themselves spread, ulcerate, and commence the career of phthisical disease, which will sooner or later destroy life. We have met with several cases of consumption that have appeared to originate in this way, independently of any distinct tuberculous disease or diathesis; the individuals having been in excellent health, and quite free from all chest complaints before the attack of acute inflammation, which afterwards degenerating into this chronic form laid the foundation of a consumption, and ultimately proved fatal. It is however slower and less intractable in its progress than the true tuberculous consumption, for the disease is more local than constitutional; and if circumstances do not occasion its extension, and injure the constitution by a constant and increasing inroad on the functions of respiration and circulation, it may be in the power of nature, aided by art, to effect its removal.

The subject of the *treatment* of chronic pneumonia will be resumed in connection with that of phthisis. It may suffice for the present to add that for those cases which succeed to acute disease, the most effectual treatment consists in a mild course of mercury in the first instance, combined with external counter-irritation, followed by a course of hydriodate of potash and sarsaparilla or some similar alterative, with a mild sea air, regular gentle exercise, and a well-regulated diet.

PULMONARY ŒDEMA.

Anatomical characters.— Causes. — Symptoms and physical signs. — Treatment.

Œdema of the lung consists in an effusion of serum into the tissue, probably both between and within the cells and minute tubes. Its *anatomical characters* are, that the lung is heavier and paler than usual, pits on pressure, crepitates little under the finger, and when cut exudes a frothy serum. It is seldom idiopathic, but like œdema of other parts results from some loss of balance in the circulation, an obstruction to the return of blood, or in a few instances an excess of exhalation. Thus it may arise from the obstructions occasioned by organic diseases of the heart, lungs, or liver, or from the increased exhalation supervening on exanthematous fevers, particularly scarlatina and rubeola, or on those diseases of the kidneys which interfere with their excretory function, and are accompanied by dropsical effusions in various parts.

Being thus a sequel of other disease rather than a pathological condition distinct in itself, the *symptoms* accompanying œdema must vary greatly according to the cause which produces it. When extensive it occasions dyspnœa, cough, and thin mucous or serous expectoration. The *physical signs* are a crepitant or subcrepitant rhonchus, with the breathing less fine and even than that of pneumonia, and giving proof of the presence of more liquid by the mucous rhonchus in some of the larger tubes. The natural vesicular murmur is rendered indistinct, especially at the lower and back part of the chest, where also the sound on percussion is impaired. These signs are very like those of the first stage of pneumonia; and the distinction is chiefly to be found in

the general symptoms; the fever, rusty expectoration, and progressive increase of pneumonia being absent, and there being present œdema of other parts, or other signs of disease that may be supposed to produce it. From our own observation we should say, that the lungs are less liable to œdema than the external cellular tissue; and they are rarely so affected unless there be also anasarca, or œdema of the limbs,

Treatment. This must depend on the nature of the cause, and be adapted to the character of the organic lesion which is generally present. The œdema which follows scarlatina and measles generally yields to hydragogue purgatives and digitalis; in addition to which general or local bleeding may in some severe cases be required.

DILATATION OF THE AIR-CELLS.

OR

PULMONARY EMPHYSEMA.

Anatomical characters.— Causes and nature — Symptoms.— Physical signs.— Prognosis.— Treatment. — Interlobular emphysema. — Nature and supposed physical signs.

This lesion, like others essentially affecting the structure, will be best understood through its anatomical characters.

Anatomical characters. These present some variety, but they have this in common, that when examined either through the pleura in the recent state, or after this membrane is inflated, dried, and sliced, the air-cells are seen much larger than those of healthy lungs. When the dilatation is general the pleural surface of the lungs may be as smooth as usual, only more convex; but when it is partial, there are seen either several enlarged vesicles or lobules forming irregular prominences. Individual vesicles are sometimes seen under the pleura, and especially at the margin of the lobes, dilated to the size of a pea, a hazel-nut, and in some cases to a much larger size. Dilatation may be partial or general: general dilatation may affect one lung, or the whole, or a considerable part of both lungs; partial dilatation may affect all the vesicles of a lobule or be confined to distinct vesicles. These different lesions may be accompanied by very opposite conditions of the texture of the lung: sometimes this has acquired an increased rigidity; it does not collapse where the chest is opened, and resists the impression of the fingers more than a healthy lung. There are notwithstanding the dilatation of the air-cells and its general lightness, hypertrophy and toughness of some of its textures, and portions near the root are sometimes found considerably indurated. With this condition there are commonly associated an altered state of the air tubes, redness and thickening of the mucous membrane, hypertrophy of the longitudinal fibres, dilatation or partial contraction. In other cases, there is the opposite condition of the lung. The texture is more flaccid and yielding than usual; and when the margin of a lobe is pressed between the fingers, it feels thin, almost like a single membrane. It often does not collapse on opening the chest, and this appears to arise from a loss of elasticity, for it pits on pressure like an œdematous lung, and is commonly much paler than usual. This is the condition which M. Lombard describes as *lobar* emphysema; and he remarks that the inter-vesicular texture seems to have been absorbed, and the bloodvessels obliterated, changes which he considers to be the cause, rather than as we view them, the effects of the dilatation. Andral has noticed this condition of the lung, under the name *atrophy*, and remarks that it occurs most frequently in old people. We have seen it both general and partial; the partial kind of flaccid dilatation

being common in the anterior lobules and margins of the lungs in tuberculous phthisis. The fringe of dilated cells like a row of beads, sometimes seen at the margin of the anterior lobes, is also simple dilatation, without the least rigidity.

Causes and nature. Laennec explained the origin of this lesion in this manner: — in cases of chronic catarrh, particularly of the dry kind, the small bronchial ramifications become so obstructed by the swelling of their membranes or by the secretion of a viscid mucus that the air can be forced through them into the vesicles only by an effort. Now, as in ordinary respiration, the inspiration, a muscular effort, is more forcible than expiration, the former may prove sufficient to overcome the obstacle to the introduction of air into the vesicles, while the expiration is inadequate to expel it. Successive portions of the air expanding by the increased temperature are thus introduced and incarcerated in the cells, which are thereby kept in a state of continued dilatation. This may be one mode in which the air-cells become dilated, but there are probably other causes more efficient and common in operation. When there is partial or complete obstruction in any of the bronchial tubes or cells, the inspired air cannot press with the usual force beyond the obstructions; but it presses with more than the usual force into the adjoining tubes and cells to which its access is quite free, and these latter may thus become distended, and in time permanently dilated. The obstructions may be caused by viscid secretions in the tubes, thickening of the textures, tuberculous deposits, and the like; and it is with diseases in which these occur, that dilatation of the air-cells is most commonly associated. Another cause of dilatation of the air-cells is rigidity or want of extensibility of the longitudinal fibres of the bronchi. This change has been already noticed as an effect of chronic bronchitis; and it is easy to perceive, that if the tubes do not lengthen with the expansion of the chest the air will press unduly on their terminating cells, and occasion their dilatation. Thus we find the margins of the lower lobes most dilated, for these are most exposed to the influence of the forces expanding the chest. It is not uncommon to find the marginal vesicles dilated in the lungs of old people with ossified cartilages; which may also be ascribed to the comparatively immobile state of the ribs and central portions of the lungs, and the increased action of the diaphragm, and consequent undue pressure of the air into the texture immediately contiguous to this part of the respiratory apparatus. Such are the chief mechanical causes by which the vesicular texture of the lung becomes distended: but there are others of a more vital nature, which may also be concerned in the production and perpetuation of this lesion.

M. Andral conceives that the air-cells sometimes become enlarged by a wasting away and breaking down of some of their walls, so that several are reduced to few of larger size. This has been shown by M. Lombard to be the case whenever the enlargement of some cells is considerable: but we are induced to consider with Dr. Carswell, that this is a consequence rather than a cause of the dilatation. The latter author has well observed that the long-continued pressure of the confined air on the vessels is a sufficient cause of their diminution, and of the atrophy of the tissues.

Dr. W. Stokes supposes that paralysis of the circular fibres of the bronchi is a chief cause of dilatation of the air-cells. Following the view which Dr. Abercrombie holds with regard to the intestinal muscles, he considers inflammation of the tunics investing the tubes, such as that of bronchitis, to be the chief cause of this paralysis. It is however doubtful, that this is more than an aiding cause in the production of pulmonary emphysema. The contractile property of the vesicular tissue is not fully proved; but its elasticity is undoubted, and it is very probable that a defect of this may assist in producing the lesion in question. But the chief agents are probably the mechanical causes of irregular distension of the lungs, which have been already noticed.

Reverting to the anatomical differences of the tense and the flaccid vesicular emphysema, we may well trace in one the effect of an over-active and irregular

nutrition of the textures, the common result of repeated or prolonged inflammation, and in the other the absence of any such process, if not the presence of one of an opposite character, causing a wasting of the same parts. It is obvious that these opposite conditions will lead to very different effects in the signs and course of the lesion. In the one case, the lungs become comparatively fixed in a distended state; and as they resist the power of the expiratory forces to expel the air from them, unusual exertion is required in inspiration to introduce sufficient air to serve the purpose of respiration. They are therefore perpetually exposed to a distending force; and as the dilatation proceeds, and the increasing rigidity or obstruction with it, the lungs acquire a permanent volume beyond what is usual even in full inspiration, and they distend the walls of the chest, and press on and even displace the adjoining organs and vessels. Hence may be expected to arise continual oppression of the functions of both respiration and circulation, and, as the sequel, cachectic and dropsical disease of the system. In flaccid vesicular dilatation on the other hand, there is little or no increase of volume of the whole lung, and no pressure on the other contents of the chest.

Symptoms. We are now prepared to understand the symptoms and signs of extensive vesicular dilatation. Inasmuch as it is permanent, it will cause a constant shortness of breath, or even dyspnœa; and the least additional obstruction, such as that of a cold, bodily exertion, or flatulent distension of the stomach, may increase this symptom to an oppressive degree, so as to resemble an attack of asthma. The permanency of the oppression to the function of respiration in severe cases induces a cachectic state of the body, which is manifested by pallidity and some emaciation, and a depraved condition of all the excretions. In the tense form of emphysema, with increased volume of the lungs, there may be superadded the symptoms of obstructed circulation as well as imperfect oxygenation of the blood, occasional lividity and even blueness of the face and lips, dropsical effusions, palpitation and other signs of hypertrophy of the heart. Dr. Stokes has remarked, that these symptoms are always worse in cases where the lower lobes of the lungs are chiefly affected, which he explains by the enlarged lungs of these parts preventing the free play of the diaphragm. The expectoration is various; most commonly it is mixed, a thin dirty, mucous fluid, with portions of tough, pearly clots, or of the opaque sputa of chronic bronchitis. In the attacks of acute bronchitis which frequently occur, it becomes glairy, and often very copious towards their termination, as in bronchorrhœa.

Of the *physical signs* of pulmonary emphysema, one of the most remarkable is the loud, hollow sound on percussion, which is even greater than that of a healthy chest. This is common to both the tense and flaccid kinds of emphysema; but in the former, when extensive, there is a distinctly *raised pitch* in the sound, such as in a less degree that which can be produced by striking the chest of a person holding in a very full breath. In fact, as in this case, the walls of the chest are rendered more tense by the increased volume of the lung, and the vibrations which they make are therefore quicker, although from the elasticity of the contained material they are still quite free. In advauced cases, the increased volume of the lung is manifest in the shape of the chest, which is unusually convex or rounded. The sides, the front, the back, and even the supra-clavicular spaces, some or all present this rounded projection; and as Dr. Stokes has observed, when the lower lobes are affected, the heart, the liver, and the spleen may be displaced by the emphysematous lung, which then yields its clear resonance on percussion over an extended region. In this tense kind of vesicular dilatation the sound of respiration is very imperfect and wheezing, and forms a remarkable contrast to the efforts used to introduce and expel the air. On inspecting the chest it can be seen that, with all the expiratory efforts, it is very little diminished, and retains its large convex shape; whilst every intercostal and every supplementary muscle can be seen at work, endeavouring in vain to depress the ribs. We can scarcely wonder that this force,

continually exerted on the thoracic vessels through the stuffed lungs, should obstruct the circulation, and cause lividity, cyanosis, dropsical effusions, and diseases of the heart. Inspiration is more easy, but even this requires exertion, for breath is taken as it were on the top of breath, and needs the supplementary aid of the cervical and superior dorsal muscles. Sometimes there are heard in the chest some odd sounds, besides the various rhonchi of the tubes, such as a sudden, loud clicking or cracking, as if from the sudden passage of air into or out of a set of tubes and cells which were before closed. Sometimes there is a sound of friction like that of a finger rubbed on a table, perhaps produced by the rubbing of projecting lobules or cells against the costal pleura.

The signs of the flaccid kind of dilated air-cells may be much modified by the other disease, such as tuberculous deposit, that commonly produces it; but they are essentially distinct from those of tense emphysema, and this difference has not been noticed by authors. There is the clear sound on percussion, but no raising of the pitch of the sound. In old people, where this form of emphysema is uncomplicated with solid deposit, the sound on percussion is clearer and deeper than in any other case. Neither the shape nor the motion of the chest is materially affected; and the sounds of respiration, instead of being obscure and wheezing, are remarkably loud and even puerile, sometimes with a little whiffing or bronchial character, probably from accompanying dilatation of the tubes. The reason of all this will be apparent when we reflect that, in these cases, air passes freely into and out of the dilated cells; and that their enlarged size, together with the increased energy which the feeling of dyspnœa gives to the acts of respiration, explains why the sound of respiration should be louder than usual.

Prognosis. When dilatation of the air-cells is so extensive as to alter the shape of the chest and to cause constant shortness of breath, there is little probability of its ever being entirely removed, and its general tendency is to increase, especially during the occurrence of any fresh attacks of bronchial inflammation. In some cases the disease, if not congenital, takes its origin in very early life, and the individual is always very short-breathed, and on the occurrence even of a common cold becomes completely asthmatic. But these are not the most severe cases; such are those which supervene to repeated and obstinate bronchial attacks which in the course of a few months may induce a formidable degree of the disease. Even these cases do not prove speedily fatal, but only after the system has suffered much and long, and disease of the heart and dropsy has supervened.

Treatment. The prevention of the disease is more attainable than its cure; and with this view we should endeavour to remove those inflammations which lead to an obstructed state of respiration, and to disperse the obstructions which they produce. The use of counter-irritants and alkaline attenuants and expectorants, and other remedies recommended for chronic bronchitis and dry catarrh, is the most successful mode of effecting these objects. We have seen, in several cases, considerable relief with marked improvement of the physical signs, from the use of small doses of hydriodate of potash and liquor potassæ, with squills and other expectorant remedies. Where there is already evidence of considerable dilatation, blisters to the chest, or frictions with a strong stimulating liniment, and the inhalation of steam impregnated with a little tar, turpentine, creosote, or even iodine, may prove of some benefit. Dr. Stokes mentions strychnia as likely to restore, in some measure, the lost contractility of the circular fibres.

The symptoms which arise in inveterate cases of pulmonary emphysema must be treated on general principles, remembering that although we may be unable to remove the cause, we may, in some degree, prevent its increase and diminish its aggravations from temporary circumstances. With this view care should be taken to avoid the renewal of bronchial inflammation and congestion, by guarding against cold, keeping the secretions free, and carefully regulating the diet. If the expectoration be not sufficiently free, and a fit of dyspnœa

occur during the night in consequence, benefit may often be derived from smoking stramonium in the evening: this excites secretion from the bronchial surface, and prevents the congestion which would otherwise ensue during the first sleep.

The flaccid form of emphysema is scarcely an object for treatment: we cannot increase the number of the pulmonary cells; but we may, in some degree, so regulate the body as to diminish the want of breath, and make the small number suffice. With this view, a tranquillizing plan of medicine and regimen, avoiding all excitements of the circulation and respiration, at the same time promoting the due activity of the secretions and tone of the system by gentle exercise and alterative tonics, may serve to keep a balance of imperfect health, and prolong existence on a lower scale.

Interlobular Emphysema is an effusion of air into the cellular membrane between the lobules and under the pleura; and, though essentially distinct from the preceding affection, it may be combined with it. It is distinguished anatomically by the air being in the lines of the interlobular septa, and contained in angular cells of various shapes and sizes, and not round ones like those of the lung. Sometimes air is effused under the pulmonary pleura, detaching it from the lung in large bubbles. This affection is commonly produced by violent efforts, or by wounds of the lung, but sometimes from rupture of the air-cells by excessive or sudden dilatation. It may, if extreme, produce sudden and even fatal oppression to the breathing; but in slighter cases it is of no consequence, and is removed spontaneously.

The only sign, supposed by Laennec to mark this affection, is a sound of rubbing with the motions of respiration, which the projecting emphysematous septa or bubbles make against the walls of the chest. This is heard and felt sometimes in successive jerks, so as to resemble the steps of a person mounting and descending a ladder.

Atrophy and Hypertrophy of the Lung.

We have already adverted to atrophy of the lung as a concomitant of flaccid dilatation of the air-cells. But the same condition not unfrequently presents itself where there is no distinct evidence of enlargement of the cells; as in the lungs of aged persons, and of those who have died after a prolonged and emaciating illness. In such cases, the textures of the whole lungs are found much thinner, softer, and paler than usual, and when collapsed they are shrunk into a very small compass. The cavity of the chest seems to be also diminished by the diaphragm occupying a higher position than usual. There are other cases in which partial atrophy of the lung can be traced in connexion with tubercle, obliteration of the bronchial tubes, and as a sequel of pleuro-pneumonia; but, in these cases, there is generally also dilatation of either the neighbouring tubes or cells. It is very reasonable to suppose with Andral and Stokes that, when from a permanent obstruction, a part of the lungs do not receive its supply of air and blood like other parts, whose functions are not exercised, it loses its substance; and it is still more interesting to conceive that the same result may affect more generally the lungs of those whose sphere of respiration is contracted by their being bed-ridden, or otherwise long limited in the exercise of the function. Such individuals, should they recover the power of being active, are short-breathed without any other disease; and although weakness of the heart and muscles of respiration may partly cause this, we must suppose that the wasting of the lung through disuse is also concerned in it.

Hypertrophy of the Lung has been already noticed in connexion with chronic pneumonia and emphysema. But we also meet with the lungs in a denser, heavier state in some other diseases, particularly those of the heart. This has been described by Dr. Clendinning, and, from much observation, we can bear testimony to the fact that, after the long continuance of organic disease of the heart, the substance of the lungs, even when not congested, is much

more dense and heavy than usual, although the vesicular texture is everywhere filled with air. The lesion of the heart with which this state of the lung is most commonly associated, is hypertrophy of the right ventricle, with difficult transmission of blood through the heart; and we can readily conceive how the increased impulsion of blood produced by the one, and the long existing congestion resulting from the other cardiac lesion, may occasion an increased growth of the solid textures of the lung. The indifferent sound on percussion which the chest often yields in such cases, may result from this change; and the permanent shortness of breath is, perhaps, also in part due to the same cause. The treatment belongs to the subject of hypertrophy of the heart, and the lesions which it induces.

TUBERCULOUS DISEASE OF THE LUNG, OR PULMONARY CONSUMPTION.

General characters. — Anatomical characters. — Pathology of pulmonary tubercles. — Symptoms — of the first — second — and third stage. — Physical signs — of the first — second — and third stage. — Complications. — Varieties. — Acute — Chronic. — Origin and causes. — Diagnosis. — Prognosis. — Treatment. — Prevention of tubercular disease.

Under this head we propose to include all those forms of disease of the lungs which arise from the formation of tuberculous matter, or of depositions and indurations which are allied to it, in the substance of the lung. By the names, *phthisis*, *consumption*, and more popularly by that of *decline*, is implied the wasting of the body from the effect of a disorganising process going on in the lungs. A disease so varied in extent and course as phthisis is can scarcely be comprehended in a definition by symptoms, but its most general character may be stated as follows: cough, with at first little or only transparent expectoration, occasionally hæmoptysis, afterwards opaque, purulent, and copious expectoration; quick pulse and fever, particularly in the evening, and ending with night-sweats; dyspnœa, or shortness of breath, gradually increasing; progressive emaciation and debility. The chief physical signs are, irregular expansion of the chest, dulness on percussion, with imperfect or bronchial sound of respiration in some of the upper parts of the chest; afterwards cavernous rhonchus, respiration, and pectoriloquy; indicating partial consolidation of the lung, followed by the formation of cavities communicating with the air-tubes.

But it would be irrational and tedious to enter into any details of the symptoms and history of the disease, without first considering the pathological nature of those changes which it causes in the lung; and as these are chiefly learned by a study of the anatomical characters of the lesions, we shall premise a brief sketch of these; and by tracing out their progress through their stages and complications, we may be enabled better to comprehend the nature of the disease, and the signs and symptoms which accompany it.

Anatomical characters. When we examine the lungs of persons who have died of consumption, we find them greatly changed from their natural condition: they are more or less consolidated in irregular masses; and on cutting into them, they are also generally found excavated into hollows of various sizes and shapes, which are either empty, or contain a thick liquid matter.

The morbid conditions may be arranged under the following heads:

1. On pressing the softer parts of the lung between the fingers, there are felt in it a number of hard little bodies; and on cutting into them they are found to be roundish granules, of a light semitransparent reddish drab, or

skin-colour, sometimes more grey or ash-coloured, more rarely devoid of colour and quite transparent; of sizes varying from a pin's head to a hempseed. Their hardness is considerable, sometimes almost equalling that of cartilage; these are the *miliary granulations* and *miliary tubercles* of Laennec and other writers. They are sometimes found isolated, and studding a tissue otherwise healthy: but more commonly they are in groups of several together; and then they are either clustered in bunches like little berries, or they form a considerable mass, with the interstitial tissue consolidated and indurated between them. They are most commonly distinct in the inferior lobes: in the upper parts, and near the the root of the lung, they are usually conglomerated in masses. In the upper parts, too, it is most common to find in them opaque specks of a yellowish white colour, which are generally in the centre of the granules, sometimes at their margins. In the distinct granulations, the opaque part is little more than a speck; but in those which form a conglomerated mass, the opacity is often seen extending from granule to granule; and in others it constitutes a mass of considerable size within the indurated cluster of granulations.

2. A consolidation of another kind is also commonly found. It is diffused through some extent of the pulmonary tissue, of no particular shape, except that sometimes it seems to be limited to single lobules: it varies in consistence: it is often nearly as hard as the miliary granulations, and in parts has somewhat of their semitransparency and colour; but generally it has a darker hue, from the colour of the blood and the black pulmonary matter in it. The consolidation is pretty complete, and the pulmonary texture cannot be distinguished in it, except here and there the coats of a large bloodvessel, bronchus, or interlobular septum, which are often thickened and partake of the induration. In other cases, the consolidation is less perfect; there being still some air in the tissue, and the adjoining portion of lung being often emphysematous. In these indurated masses, are often to be seen, here and there, more opaque lightcoloured spots, which are sometimes quite distinct, and of a dead yellowish white, like those seen in the miliary granulations: but they are here less regular in their shape and size; being sometimes in streaks, curves, and angles, and mottling the dark consolidated texture with spots and patches of a lighter and opaque hue. In the lightest and most opaque spots we recognise what must be described as the next class of morbid appearances to be met with in phthisical lungs, namely, —

3. Opaque yellowish white masses of various form and size, generally somewhat rounded. Some of these are nearly as solid as the dark or semitransparent indurations, but they are much less tough; others have more or less of a cheesy consistence; and some are found in parts approaching to a state of grumous fluidity, still retaining their light colour and opacity. These opaque masses are commonly found within the indurations from which they appear to be formed, and they are just of the same character as the specks before described as occurring in some of the single or aggregated miliary granulations. In fact, as these specks are seen (in some in greater number and extent, and preceded by an intermediate state of opacity) in parts to pervade the whole mass, it may be fairly concluded that the clusters and nodules of granulations are also converted into this same opaque friable yellowish white matter. This matter, which is indisputably entitled to be distinguished as tuberculous, is occasionally found also in other situations, unaccompanied by any induration; such as in the interior of dilated vesicles and bronchial tubes, in masses under the pulmonary pleura, and in the bronchial glands. In these instances, it is commonly of a more friable and cheesy consistence, and has not the hardness which it seems to retain for a while when it has originated in the indurated tissue. But this yellow tuberculous matter, however tough and hard it may be in the first instance, tends to soften, partially or wholly; and thus the masses are sometimes found consisting of loose clots in a purilaginous fluid, or wholly reduced to a curdy or cheesy kind of puriform matter. The tuber-

culous matter is also not unfrequently found diffused through a considerable extent of the pulmonary texture, constituting the *infiltrated tubercle* of Laennec. In its earlier condition, the lung in this state closely resembles the advanced stage of hepatisation, when the opacity which precedes suppuration shows itself. It is very much mottled or marbled; for, besides the yellowish white opacity, which is seen in different degrees, there is the black pulmonary matter, giving it a grey or greenish colour, besides the white coats of vessels and interlobular septa, and red spots of tissue less affected. When the lung in this state is cut or torn, which it commonly may be with facility, its interior presents a granular surface like that of hepatisation; and except that its colour is more varied, and it has generally more of the light opacity of tuberculous matter, it resembles a hepatised lung very closely. But in it there are often found what are rarely met with in hepatised lungs — circumscribed abscesses or cavities containing a fluid matter. To this softened and fluid state, then, all the conditions which we have been describing tend to pass, and thus are formed *vomicæ*, the matter of which being evacuated into the bronchial tubes, leave the form of lesion next to be mentioned.

4. Lastly, we find cavities or excavations very various in number and form, and of sizes from that of a cherry-stone upwards to the extent of a whole lobe. Sometimes they contain more or less of the remains of the softened tubercle, or a more liquid pus, or a mixed serous, mucous, and purulent fluid tinged with blood, or they may be empty. They communicate with the air-tubes, and often with each other, — the process of softening and ulceration having opened the passage; but bloodvessels and interlobular septa are often found to have escaped the destructive process, and form cords or bands across the cavities. The bloodvessels are, however, almost always impervious in these cases, and the septa are thickened by the deposition of lymph. The walls of the cavities are composed of the consolidated tissue of the lung, rough, and sometimes sloughy; or of an irregular coat of lymph; or, in old cavities, of a kind of new membrane, which in some cases is thin and fine like a mucous membrane, and in others thick, rigid, and more of a fibro-cartilaginous character. When these cavities approach to the pleural surface of the lung, there is often a coating of lymph or false membrane on the pleura at the part, which either thickens in it, or unites it by adhesions to the costal pleura. Sometimes, however, there is no such deposit or adhesion; and it occasionally happens that the pleura is also ulcerated, and being perforated, allows the contents of the cavity, and the air from the bronchi, to pass into the pleural sac, causing pneumothorax and pleuritic inflammation. There is this remarkable in the position and size of the cavities, — that they are almost always largest and most numerous near the summits of the lungs; there being often one or more cavities there, when in the inferior lobes there are only scattered indurations. In fact, it may generally be observed of all the lesions connected with phthisis, that they affect the upper and posterior more than the lower and anterior lobes; and that they are also more advanced in the former. This is, however, more remarkable with the circumscribed indurations and tubercles; for with the diffused consolidations, especially of the light opaque kind (tuberculous infiltration), the middle and inferior lobes are often also affected, and cavities are commonly found in every part.

Besides these chief and more essential changes of the lungs in phthisis, many others are often found of a more accidental character, such as hæmorrhagic effusion and consolidation; inflammatory congestion and hepatisation of the lung; products of inflammation in the pleura; inflammation, ulceration, thickening, and dilatation of the bronchial tubes; irregular dilatation of the air-cells, sometimes with increased flaccidity, sometimes with rigidity; enlargement and induration of the bronchial glands, with yellow tuberculous matter in its different states in them. The last affection is of common occurrence in children; and, according to Dr. Carswell, sometimes exists to such an

extent as to cause the glands to swell and press on the trachea near its bifurcation.

Besides in the lungs, various lesions are frequently found in other organs in the consumptive. The trachea and larynx are not uncommonly ulcerated, particularly in those parts over which the matter expectorated most commonly passes. Hence the side of the trachea and branches next to large cavities in the lungs, and the under surface of the vocal cords and epiglottis, are more commonly the seat of these ulcerations. Louis met with ulceration of the larynx in one fifth of the cases of phthisis which he examined, and of the trachea in a third; whilst these lesions were met with only once in 122 cases not phthisical. MM. Trousseau and Belloc have also shown that ulceration of the larynx is generally, but not constantly, connected with pulmonary tubercles. The ulcers are very various in number and size, and they do not often extend below the mucous and submucous membranes.

Tuberculous disease is found in other parts besides the lungs, in a large proportion of consumptive cases; the situation of its prevalence varying with the age of the subject. Thus Papavoine found it, in children especially to occur in the cervical and mesenteric glands, in the spleen, pleura, liver, and small intestines; less frequently in the peritoneum, large intestines; and rarely in other parts. In the consumptive cases above the age of fifteen, examined by Louis, tubercles were found in the small intestines in one third of the whole; in the mesenteric glands in a fourth; in the large intestines in a ninth; in the cervical glands in a tenth; in the lumbar glands in a twelfth; in the spleen in a fourteenth, of all the cases; and in other parts in smaller proportions. In by far the greater number of cases, the tubercle in these different parts seems to be of more recent date than those in the lungs.

The intestines are very commonly more or less ulcerated in pulmonary consumption. Louis found this lesion in five sixths of his cases; and in the large intestines, besides ulceration, there were thickening, softening, and increased redness; and out of the whole number which he examined, in three instances only were the large intestines found quite healthy. The liver not uncommonly presents a very peculiar appearance in phthisical subjects. Louis remarked, that in two thirds of his cases the stomach was remarkably distended, sometimes acquiring double or treble its usual size, and reaching down to the pubis; a condition rarely to be met with in other diseases.

A very remarkable change is often found in the liver of phthisical subjects, caused by the deposition of a kind of fatty matter in its structure. The bulk of the organ is generally increased; it is softer than usual, and of a paler colour, and on being cut greases the knife, or more evidently shows its oily quality on a slice of it being heated on paper. This state of the liver does not occur in all cases of phthisis, and is more common in females than in males: it is found in rapid as much as in prolonged cases. The function of the liver does not seem to be much impaired by this change, for the ducts contain bile as usual.

Pathology of pulmonary tubercle. The characteristic changes which anatomy discovers in the lungs of the consumptive, may for the most part be reduced to two. 1. Consolidation, generally indurated, either almost colourless and semi-transparent, or pearly grey, or reddish drab, or of a dark red or more dingy colour. 2. An opaque yellowish white or parsnep-coloured friable matter, of various degrees of consistency, being first more or less hard, and afterwards becoming soft and forming vomicæ: this lighter opaque matter, which is properly called tuberculous, is produced commonly within the consolidations just named, but sometimes elsewhere. We proceed to advert shortly to the opinions of some eminent modern pathologists on the nature and origin of these lesions.

Laennec considered tubercles, "accidental productions — that is, real foreign bodies — which spring up in the substance of the lungs, and may be developed in any other texture of the body." We owe great respect to the name of Laennec, but we must in candour confess that his views of the nature and origin of tubercle are neither satisfactory nor altogether intelligible It may

be collected from his writings, that tubercles are parasitical bodies originating in an unknown way, possessing a life and structure of their own, growing by attracting matter to them, and tending by their own inherent properties to go through a certain series of changes. The transparent miliary granulations of Bayle, the grey miliary tubercles, the grey diffused induration, and a kind of gelatinous infiltration, he looked on as varieties of these bodies in their first stage, and as all tending, *per se*, first to become opaque and yellow, or crude tubercle, which is still hard; and afterwards to soften into a cheesy or pasty liquid, which is the mature tubercle. Now this view involves several assumptions little supported by analogy;—for instance, that bodies so different in physical character and texture are the same; and that the stages through which they pass are produced by assumed inherent properties, and not by the modified properties of the tissue of the organ;—and it further assumes what has been disproved by extended observation,—that the opaque yellow tubercle is always preceded by the grey or semi-transparent, and that the grey induration must always in time become yellow tubercle. Whilst we admit the accuracy of Laennec's observation, that the grey and semitransparent indurations tend generally to become yellow tubercle, we must consider his view of the change to be too hypothetical and unsupported to be received as satisfactory.

The view of M. Andral is far more simple, and involves fewer assumptions. He considers tubercles generally to be the result of a modified nutrition of the textures; and that they are produced and go through their changes by the agency of the vessels of the part, and the blood which circulates in them. Although he admits that the miliary and diffused indurations precede the production of yellow tuberculous matter, he supposes them to be not an early stage of this matter, but the result of chronic inflammation affecting the individual vesicles, or the general texture. The chief peculiarity of this view is, the explanation of the regular form and size of miliary tubercles, by locating them in the individual air-vesicles, just as the same author first accounted for the granulations of a hepatised lung. That the diffused induration, called by Laennec the first stage of tubercle, is the result of chronic inflammation, has been admitted by Chomel and Louis, who otherwise rather incline to Laennec's views.

The most recent writer on this subject is Dr. Carswell, who has developed his views in his admirable *Illustrations of the Elementary Forms of Disease.* He neither adopts the opinion that the indurations are an early stage of yellow tubercle, nor does he admit that they are more than accidentally connected with it. He supposes yellow tubercle to be a peculiar secretion, which takes place especially from mucous membranes; but that it may accompany other secretions, such as that of inspissated mucus in the air-vesicles, or of dense false membranes on the pleura or peritoneum; and thus he accounts for the grey miliary bodies with specks of yellow tuberculous matter, and the similar admixture of this matter with deposits on serous membranes. But on minutely examining the miliary granulations of the lungs, we find no *inspissated mucus* in them to account for their hardness; the induration is obviously in the texture itself, and not merely contained within the cells. Dr. Carswell's view, therefore, throws no light on the manner in which yellow tubercle is produced in the grey or dark indurations, whether miliary or diffused; yet this is a point as well established as any in the pathology of phthisis.

It would take more space than we can spare, to enter into further particulars of the different opinions which have been held in regard to tubercle. If we consider the subject of the pathological changes of the lungs in phthisis, rationally, and in connection with what we have learnt of those in other textures, and other diseases, we may hope to attain a more consistent and satisfactory view of the subject. The researches and opinions of Professor Alison have led the way in this inquiry, and we are indebted to him for some of the succeeding observations.

If we examine the induration that commonly precedes the production of yellow tubercle, we find that it differs from the healthy structure, certainly in

these respects,—that it contains a greatly increased quantity of matter, and that this matter is generally harder than the healthy tissue. Now, this increase of substance implies either increased secretion or diminished absorption: that absorption is not diminished in the tissue, is plain, from the fact that portions of the healthy texture are at the same time removed by this process, around the indurations; and that increased secretion is present, is proved by the fact, that the indurated texture presents new characters, and is not a simple accumulation of the matter of the natural tissue. Now, to produce an increase in the nutritive secretion, there must, according to a well-established pathological law, be an increased determination of blood to the part. Let us now inquire, whether increased determination of blood in other cases leads to the production of matter like that of the indurations; and as the most distinct form of determination of blood, we first take inflammation.

In treating of pleurisy, we found that acute inflammation of the pleura causes an overflow of the nutritive secretion, in the form of coagulable lymph, which may soon become well organised into a soft cellular or serous membrane; but when the inflammation is of a lower and more chronic character, the effused matter is slower in the process of organisation, and forms a harder texture of lower vitality,—a kind of fibrous or fibro-cartilaginous structure. The same observations will apply to the parenchyma of the lung. The overflow of the nutritive secretion, caused by acute pneumonia, we have found to constitute red hepatisation, whether granular or diffused; but on examining the effect of lower and more prolonged inflammation on the tissue of the lung, we formerly described a dark consolidation with increased density, in no essential particular differing from some forms of the indurations of phthisical lungs. Thus the hard, compact, granular consolidations occurring around excavations, gangrenous as well as tuberculous, and admitted, even by Laennec, to be the result of chronic inflammation, has sometimes the colour and consistence of the indurations which precede the formation of yellow tubercles; and as we have shown that there is a non-granular form of acute hepatisation, so it is reasonable to expect that there may be a uniform or diffused kind of consolidation, resulting from chronic inflammation, affecting the interstitial more than the vesicular tissue. To such a condition, the grey diffused induration, called by Laennec the first stage of tubercle, so exactly answers, that Andral, Chomel, Louis, and Carswell all concur in considering it a chronic form of hepatisation. When it is the sequel of the acute disease, or of long continued pulmonary congestion, there is often much redness in the induration; but where the irritation has been of long continuance, and unattended with the more sthenic degrees of vascular action, or a very congested state of the lung, the texture is more semitransparent, dense, and grey, or variously modified by the black pulmonary matter in it. The more uniform or colourless masses occasionally present, may be traced to be the interlobular septa, or cellular tissue around the vessel, in a state of indurated hypertrophy. In these bloodless and almost cartilaginous portions, we see the exact characters of the matter of which the miliary granulations or grey miliary tubercles are minute samples; and if we adopt the view of Andral, that the regular size of these depends on the chronic induration being located in the coats of individual vesicles, we shall see a sufficient reason for their being regular in form, and isolated or in clusters. Moreover, as we have traced the diffused consolidations of the lung through various gradations, from acute soft red hepatisation down to grey induration, so M. Andral has found the miliary bodies presenting the same gradations; being sometimes soft and red, in other cases livid and harder, whilst the same lung may contain also the granulations similar in size, but pale or grey, and of different degrees of induration. We have twice met with the more rare transparent miliary granulations of Bayle, on the pleura and peritoneum, in conjunction with dense false membranes, and without any yellow tubercles there or elsewhere. As to the commoner pale granular deposits on serous membranes, they are the acknowledged products of chronic inflammation, and their numbers and circumscribed

form constitute another point of resemblance to the miliary indurations, which in the lung pass into the state of yellow tubercle. Without, then, going so far as to assert that the miliary indurations of the pulmonary tissue are always dependent on chronic inflammation, we may fairly say that both they and the diffused induration are more akin to the products of this process, than to any other that we are acquainted with.

The condition of the blood we found to be a material element in determining the products of inflammation in the case of pleurisy; so, doubtless, it is likewise concerned in the modified putritive secretions of other textures. The more vital and organisable products are furnished by blood rich in fibrine; and they are easily reabsorbed; or if organised, are mobile, and sufficiently like the tissues of the part, not to incommode or irritate them. But if the blood be poor in nutrient matter, the deposit from it may be susceptible of only a low degree of organisation, and will consequently be not only more difficult of absorption, but less assimilable to the texture of the part. and more calculated to irritate it as a foreign body. It will thus appear, that although the lowest degrees of inflammation may be alone capable of producing the chronic indurations, when the blood is healthy, yet, when it is diseased, various degrees of inflammation or congestion — nay. even the ordinary nutrient process, without hyperæmia may be accompanied by the deposition of a lymph of degraded character, and organisable only into a dense semicartilaginous tissue.

The semitransparent grey or dark induration is not always converted into crude yellow tubercle. Sometimes it is the seat of vomicæ which contain a dirty or bloody pus; and although even in this the curdy matter of tubercle is sometimes seen, it is plain that these vomicæ result from a more direct and speedy process of ulceration or irregular suppuration; another anologous result of continued irritation in the condensed tissue.

Let us now pursue the same inquiry with regard to the opaque pale yellow matter which characterises the second class of phthisical lesions. Laennec calls this the second stage of tubercle; but neither for its formation, nor for its subsequent softening, does he assign any other cause than an assumed and unintelligible "inherent property." Dr. Carswell is more explicit on this point; and all his descriptions of tubercle apply only to this kind of matter. He considers it to be a secretion *sui generis*, totally destitute of organisation; an effete matter, continually separated from blood in an unhealthy state; thrown out chiefly on the free surface of mucous membranes; and producing bad consequences only in proportion as it accumulates in organs, impedes their functions, and acts on them as foreign matter. This opinion, so far as it relates to the nature of tuberculous matter, does not differ materially from that long since published by M. Andral, who regards tuberculous matter as a peculiar secretion, formed under the influence of a particular diathesis or condition of the blood, and especially in connection with an irritation, inflammation, or congestion of the blood-vessels of the part.

If we survey the general characters of tuberculous matter, consisting of pale opaque albuminous particles, generally deposited in a tissue previously consolidated, and the manner in which it tends to become liquid, forming circumscribed collections like abscesses, or infiltrated through the texture, from which it is expelled like foreign matter, we cannot fail to see some general resemblances to the process of suppuration. We have found that the consolidating lymph of a hepatised lung becomes opaque and light coloured before it softens into pus; but the changes here are too rapid to admit of their being fully watched. But when an analogous process goes on more slowly, and in a simple structure as the pleura, we can better trace the resemblance. Thus, in the latent and more protracted forms of pleurisy, the lymph first effused forms a dense tissue of low vitality, and resembling cartilage in hardness and colour. If the irritation still continue, this new structure throws out a lymph of still lower vitality, in friable shreds, and in some instances in form of a curdy matter, totally incapable of organisation, which, mixing with the effused serum,

constitutes one kind of empyema. Now, such a process in the pulmonary tissue would resemble all the changes which we have been describing in the production successively of the grey induration, crude tubercle, and softened tubercle. Thus a portion of this tissue (whether a single vesicle, or part of a lobe) generally under the influence of chronic inflammation or local congestion, becomes indurated by the effusion of lymph susceptible of a low organisation. The original irritation continuing, or the very induration itself determining an increased flow of blood to the part, the new structure evolves, in the looser parts of its substance, a still less organic form of albuminous matter, a pale, opaque, curdy substance; but as this cannot be (like that from the pleura) thrown off, it presses on its indurated matrix, and, causing its absorption, accumulates in its place: thus is affected the conversion of the grey induration into crude yellow tubercle. This entirely inorganised substance, acting as a foreign body on the adjoining tissues and the remains of the living texture within it, causes irritation, ulceration, and the effusion of serum and pus, which, as M. Lombard first explained, softens and breaks up the crude tubercle into the curdy grumous matter of the mature tubercle. The same irritation and ulceration gives vent to the matter through one or more bronchial tubes; and thus are formed the tuberculous cavities.

But we have seen that yellow tuberculous matter is produced not only in the grey indurations, whether granular or diffused, but also in softer consolidations like that of hepatisation. It is sometimes seen in rounded circumscribed masses in a hepatised lung; in other instances, it pervades, with its opaque yellowish grey or mottled colour, a whole consolidated lobe. In this — the *infiltrated tubercle* of Laennec, the *grey hepatisation* of Andral — there are often here and there cavities containing a curdy pus, and communicating with the ulcerated bronchi. There are also occasionally found in it circumscribed indurations and tubercles of older date; but in other instances, no other form of chronic lesion is present, and the lung has the appearance of inflammatory engorgement in some parts, of common red hepatisation in others, whilst other portions of the same consistence have the opaque yellowish colour of tubercle; and these conditions pass by such imperceptible gradations into each other, that it is impossible to avoid the conclusion that they are parts of the same process. We see a similar variety sometimes poured out by the inflamed pleura, where one part is covered with good lymph, another with a curdy matter like crude tubercle, whilst many albuminous particles, also in an unorganisable state, are thrown off with the liquid into the sac. So also, in the very masses of coagulable lymph that an inflamed pleura or peritoneum throws out, there have been found distinct purulent and tuberculous deposits. Nor is this surprising, when we consider that lymph, pus, and tubercle are the same albuminous matter, and differ from each other in mechanical condition, and susceptibility of organisation, rather than in their chemical nature. According to the microscopic researches of Gendrin, part of which we have followed, lymph is composed of regular globules, which, by a vital attraction, string themselves into fibres and films, which may become organised and form membranes. Pus consists of larger and less regular globules suspended in serum; but these globules have no vital attraction for each other, and remain loose, and consequently insusceptible of further organisation. Tuberculous matter is wholly devoid of organic form; its particles not even being globular, but irregular, like those of mere dirt or clay; and it must remain where formed, a dead inert mass, until decomposed by chemical agency, or changed by the operation of the surrounding tissues. It is obvious that these different properties, although possessed by matter chemically the same, and from the same source, may lead to all that variety of results which we know to follow organisable, purulent, and tuberculous deposits. But the characters of these matters are not always distinct; lymph is not always equally organisable; nor is it always free from the greenish colour and less coherent globularity of pus, nor even from the lifeless curdy particles of tubercle; and tuberculous matter often contains flakes or films of imperfect lymph.

The diffused tuberculation or infiltration of the lung from inflammation, lately noticed, generally presents matter in this transition state. It is neither good organisable lymph, nor wholly unorganised tubercle; and the albuminous effusions on serous and mucous surfaces not unfrequently present such an intermediate state, that it is difficult to determine to which class they belong.

But, lastly, we have found that tuberculous matter is sometimes deposited in tissues bearing no marks of inflammation or other disease. The structures thus affected are commonly those either very vascular naturally, or peculiarly liable to congestion of blood; and viewing tuberculous matter as a deposit of unhealthy fibrine from the blood, we see a reason, as Dr. Carswell observes, why it is most likely to be found in those organs where the blood accumulates or passes slowly. Whatever be the cause which in these cases determines the deposit of tubercle, we know that pus also is sometimes secreted in parts unaffected with inflammation, as in the purulent deposits in the viscera after injuries or surgical operations; and in the profuse purulent discharges from the bronchial membrane, where it is found after death free from all trace of inflammation; nay, something like pus has been found in the blood and in the centre of fibrinous coagula in the heart, when no suppurating surface existed in the body: so likewise tuberculous matter has been met with in coagula in the heart, spleen, and bloodvessels. This tends to show that the fibrine of the blood is liable to be converted into tubercle independently of any action of the vessels; it loses its vitality, and may in proportion be merely deposited in tissues or on surfaces, independently of irritation. Here, again, as with the grey indurations, we are led to trace to the condition of the blood, one cause of consumptive disease of the lung; and it is probably a diseased state of this fluid that constitutes what is called the tuberculous or scrofulous diathesis, in which there is a tendency, by vessels in different degrees of activity, to deposit tubercle instead of lymph; and when this diseased state exists to a great extent, the tuberculous matter is excreted from the blood without any increased vascular action, and merely as an accompaniment of the natural secretion of a membrane, or instead of the ordinary nutrient deposit of a tissue. Whatever, in such cases, determines the first deposition of tubercle in a tissue, will with greater facility effect its increase, by the addition of similar matter to a ready-formed nucleus. The tendency to the deposit of yellow tubercle independently of irritation, implies a condition of the blood even more depraved than that which leads, under the same circumstances, to the formation of the chronic indurations; it is an ulterior degradation of the fibrinous nutriment of the tissues, replacing them by a matter not merely inapt in texture, and of lower vitality, but wholly destitute of life, the principle of organisation. When, therefore, tuberculous matter is found in an uninflamed tissue, it may be regarded as a sign of the most decided constitutional taint. In such conditions of the system, tuberculous depositions may take place with great rapidity; and as they are already almost ripe for elimination, the ulceration and destruction of the lung will soon follow. But nothing can give development to the tuberculous disease with such fearful rapidity, as the occurrence of acute inflammation in the pulmonary tissue. It is, we believe, from this process in a highly tuberculous constitution, that the general tuberculous consolidation called infiltrated tubercle takes place. The matter deposited is often a mixture, or intermediate state of lymph and tubercle, one product predominating in some parts, and the other elsewhere; but it is altogether beyond the reach of the sorbefacient remedies, which avail in pneumonia to promote the absorption of simple lymph; and if it do not destroy life by its solid interference with the function of the lung, it speedily runs in many points into softening and suppuration, and the patient is carried off by a *galloping* consumption. In this case the lungs are found extensively solidified, and, on incision, incipient cavities are seen almost in every part; but there is no induration; the most solid parts have scarcely more substance than a hepatised lung, and they even more readily break down under the fingers.

The development of the indurations is a work of more time; and their structure makes the destructive process which they induce more tardy; nay, the diffused indurations which form the walls of softened tubercles and vomicæ seem to be a provision of nature against the spread of the consuming disease; but under certain circumstances, even the indurations are formed to such an extent and so soon, that the patient is destroyed by their first development, or rather by the effusion of mucus or of serum which they excite. In most cases, the first formation of granulations is not sufficient to prove fatal; but as some of these are becoming changed to tubercle and vomicæ, another deposition or crop of them (as Laennec terms it) takes place and causes suffocation.

After what has been stated, it will hardly be necessary to discuss the question of the seat of the hard grey and the yellow tuberculous deposition. If the tubercle be, as we suppose, a degraded condition of the fibrine or nutrient principle of the blood, we may expect it to be deposited wherever the nutritive or the secreting process is carried on, wherever lymph or pus is occasionally found,—wherever, in short, bloodvessels run. We cannot assent to the opinion of Dr. Carswell, that tuberculous matter is in the early stage of the disease secreted in equal abundance from all parts of the mucous membrane, and that the only reason why it accumulates sooner and more in the upper lobes is, that their smaller extent of motion prevents its perfect elimination from those parts; were this the true view, how easy would be the diagnosis of consumption in its earliest stage! For there would be abundant expectoration of tuberculous matter from the lower lobes, whilst the accumulation takes place in the upper; yet it is rare to see any expectoration in the earliest stage, except a thin transparent mucus. More probable is the opinion of Broussais, that the upper lobes are the first and most extensive seat of tuberculous change, because the bronchial tubes are shorter, and more readily permit inflammation and irritation to pass to the cells. But we apprehend that the real reason of their peculiar liability is in the greater abundance of interstitial tissue in them. The bronchi, instead of being lengthened out into mere membranous tubes before they terminate in cells, divide more immediately and abruptly into short branches and cells; and the delicate vesicular structure is thus mixed up with a good deal of the interstitial cellular tissue that every where surrounds the earlier bronchial divisions. The smaller capability of motion possessed by the upper lobes of the lungs may, too, have a share in disposing them to become the seat of tubercular deposit, not by permitting it to accumulate, but by favouring bronchial obstructions to the respiration, and causing local congestions of blood, which may promote the formation of tubercles. It is not the yellow tubercle chiefly that predominates in the upper parts of the lung; it is rather the grey indurations which become afterwards converted into yellow tubercle. Primary tuberculous deposits are nearly as common in other parts of the lung as at the apex.

We have described the ordinary changes of tubercle from its primary deposition to its softening and evacuation, and the formation of an ulcerous cavern. These caverns become, if life last, lined with a deposit of a mixed nature, but with an albuminous lymph for its basis; and this is commonly mingled with tuberculous and purulent matter. Hence it seldom lasts long, but is broken up, detached, and expectorated. When the constitutional powers are stronger, and the lung less extensively diseased, the coating of the cavity is susceptible of organisation, and in time forms a fibrous or fibro-cartilaginous membrane which pretty smoothly lines the cavity. If the cavity communicate pretty freely with the bronchi, it will be kept by the pressure of the air from any considerable contraction to which it naturally tends: but in some instances the tubes become obstructed, and the membrane contracts, and tends to obliterate the cavity, sometimes leaving only a cicatrix. Such contracted cavities and cicatrices are not unfrequently met with in the lungs of old people; but they are rarely quite empty; they contain more or less of a pale yellow plaster-like matter, consisting chiefly of carbonate and phosphate of lime; and sometimes there are concretions of the same matter. The contraction is evident from the puckering of the pulmonary

tissue visible on the pleural surface near the cavity, and some of the adjoining vesicles are generally dilated to fill up the space. There are often, also, some remains of grey induration around them. The cretaceous matter is probably secreted by the walls of the cavity; but it may be the débris of tuberculous or purulent matter, the animal matter being absorbed away, and the earthy insoluble salts left, accumulated from successive depositions. This earthy matter is sometimes connected with an earlier stage of tuberculous formation. We have, in lungs not extensively diseased, found pale yellowish tubercles, composed of concentric layers of almost cartilaginous hardness; in another part of the same lung, these layers are loosened by a plaster-like gritty matter of a calcareous nature; and in another part, a whole tubercle may consist of this, having only a few flakes of albuminous matter in it, and sometimes containing concretions. This more resembles what is commonly called the atheromatous structure, which especially invades the coats of the arteries and the fibrous parts of the valves of the heart. It is to be classed with grey and yellow tubercle, in so far as it is another variety of matter, low in the scale of organisation, and formed of lymph of defective vitality. In these latter cases there is no puckering or contraction about the tubercle until it has evacuated its contents, which it is very slow to do; for it has not the tendency to soften and cause ulceration that makes common scrofulous tubercle so destructive. We have repeatedly seen a few of these tubercles in lungs otherwise healthy, the individuals having died of some other disease.

Symptoms. As we have made the anatomical and pathological changes of phthisis the basis of our description of this disease, it will be convenient and instructive to classify, as far as we can, the symptoms, in reference to these changes. The course of consumption is generally divided into three stages, according to the state of the lesions of the lungs. The *first stage* is that of the formation of the indurations, granular or diffused; the *second* is that of the conversion of these into yellow tubercle, with the extension of this lesion to other parts; the *third* is that of their softening and evacuation, and the formation of vomicæ.

First stage. The symptoms produced by the indurations may be divided into those of irritation, and those of obstruction.

The indurations are generally accompanied by various irritations, both local and general. Of the local irritations, the earliest is cough, which at first is generally slight and merely hacking, but more or less constant; at least, although it may not be frequent, it does not cease for a whole day together. It is either dry, or accompanied by a thin transparent expectoration. Another occasional sign of local irritation is pain in the chest, commonly referred to the sternum: in some instances it is a stitch in the side; sometimes it is a soreness, or an unusual sensibility to cold or exertion, more than actual pain; not unfrequently it is absent. These varieties of pain are sometimes merely irritations; but not unfrequently they are the result of real local inflammation, excited in the lungs, the bronchi, or the pleura, by the indurations. Of the more general irritations, quickness of the pulse is the most constant; but even this is not universal. The quickness is often not uniform at first, but depends on any cause of excitement, however trifling; and the pulse may be very slow and weak in the intervals: but as the organic lesion increases, it gradually becomes more constant, and is accompanied by an irritated state of other functions;—a general febrile state. But even then there is not power enough in the circulation to maintain a general or constantly increased heat; it is manifested most towards night, after the accumulated excitements of the day, when the fulness as well as the frequency of the pulse increases, and there is a flushing of the face and heat in the palms of the hands and soles of the feet, where the thickness and hardness of the cuticle prevent the perspiration and evaporation which moderate the temperature of other parts. Like other weak and intermittent febrile movements, this generally terminates by perspiration more or less profuse, which, occurring in the night, leaves the pulse lowered, but the frame weakened and

exhausted in the morning. It is only in the severe cases that this general irritation, or hectic fever, as it is termed, becomes marked at this early stage of the disease. Often there is gastric irritation, with a white tongue, red at the edges, thirst, costive bowels, and turbid urine. These symptoms are generally more remarkable in this than in the after stages, when the irritation is more confined to the organs of circulation and respiration. They are almost always attended by some diminution of flesh and strength, which, however, varies greatly in degree in different instances.

The symptoms from obstruction comprehend those from obstructions to the passage of the air, to that of the blood, and to the motions of the lungs in respiration. The indurations, granular and diffused, when extensive, by obstructing the passage of air to more or fewer of the air-cells, cause the shortness of breath, felt at first only on exertion, so common even in the early stage of consumption. Nay, cases happen, in which an abundant formation of miliary tubercles, together with the œdema, or bronchorrhœa, which they excite, prove fatal in the first stage, by the obstruction which they cause to the passage of the air. In such cases there is generally considerable fever, with short frequent cough, very quick pulse, and heat of skin, with other symptoms resembling an acute attack of bronchitis or pneumonia; for which they may be mistaken, but for the less sustained character of the fever, the greater permanency of the disorder of the respiratory organs, the physical signs, and the expectoration, which, instead of exhibiting the peculiar aspect of that of pneumonia, or the successive changes of that of bronchitis, continues mucous and frothy, sometimes abundant, but often in small proportion to the cough and dyspnœa. Partial indurations sometimes cause shortness of breath, not only by their direct impediment, but also by occasioning a dilatation of the air-cells.

The indurations, by obstructing the bloodvessels, give rise to many formidable pathological effects. They may thus cause sanguineous congestion, hæmorrhage, inflammation, œdema, gangrene, and atrophy of the pulmonary texture, hæmoptysis, profuse bronchial secretion, effusion into the pleura, disease of the heart, &c.; and the symptoms which these lesions produce may be variously grouped in the history of different cases of phthisis. The hæmoptysis occurring in the early stages of phthisis is generally from this cause; and it is a serious symptom, not only because it may endanger life by loss of blood or direct suffocation, but also because it is often accompanied by hæmorrhagic consolidation and rupture of the texture of the lung, which tend to accelerate the disorganising process, and promote the further deposition of tubercle. In some instances, however, hæmoptysis is followed by decided relief to the dispnœa and cough, having removed a congested state of the blood vessels.

Obstruction to the motion of the lungs may be caused by the same circumstances which impede the free admission of air to them; but in case of extensive solid deposition, it may also result from their mechanical resistance to the motions of the chest; and this not only constitutes a phthisical sign, which we shall hereafter consider, but it also keeps the intervening unaffected tissue in a fixed state, liable to constant congestion and further deposit, and thus adds further to the incapacity of the organs. When once the integrity of a nicely adjusted apparatus like that of respiration is extensively injured, disorder begets disorder, and unless the counteracting or respiratory powers soon come into operation, unless the indurations are soon diminished, or the bloodvessels closed, the whole of that part of the lung may soon become a solid mass. Thus, we believe, sometimes arise those extensive masses of induration which are so commonly met with in the upper parts of the lung.

Second stage. On the conversion of the grey or dark red indurations into crude yellow tubercle, and during the original deposition of this matter, besides the symptoms of irritation and obstruction, which still continue, there are indications of increasing cachexia, languor, loss of flesh and strength, and a general depression of the functions. The pulse loses strength, although it is as frequent as before; the evening chills are more severe; the fever is of

shorter duration; the sweats are more profuse. Except at times of excitement, the colour of the cheek fades, or is reduced to a circumscribed hectic patch: the expectoration becomes more abundant, or less thin and transparent, and particles of curdy or cheesy matter can sometimes be detected in it; occasionally it is streaked with blood; and in a few cases there may be hæmoptysis to a considerable extent. There is often less feeling of oppression or pain in the chest than before, but the shortness of breath on exertion is undiminished, if not increased; and there are frequently transient pains in the shoulder or under the clavicle of one side, which the patient commonly considers to be rheumatic.

Third stage. The more truly consumptive symptoms which had begun to manifest themselves in the second stage, are developed fully when the tubercles become soft, partially or entirely liquid, and are evacuated, by the aid of the secretion and ulceration of the adjoining textures. Then comes on, in addition to the symptoms before described, a copious and heterogeneous expectoration of pus, mucus, softened and occasionally solid tubercle, blood, shreds of lymph, and rarely portions of pulmonary tissue in a sloughy fetid state. Then occur the usual constitutional concomitants of extensive unhealthy suppurating ulcers, confirmed hectic with its successive chills, heats, and sweating, occasionally diarrhœa, and the increasing marasmus, in this case rendered more pronounced by the importance of the organ affected and the relations which it bears to the process of sanguification. Then are the dyspnœa and cough increased by the continual discharge of matter into the air-passages, and by the extension of the diseased depositions and ulcerations of the tissue. Yet it is a curious circumstance, that these symptoms are often inconsiderable in proportion to the terrible extent of the organic mischief which has been produced: the dyspnœa often is not painful like that of asthma; it is a state of breathlessness rather than of distressing oppression; the cough is commonly less violent than in chronic bronchitis; the pain may be slight, or there may be none at all; the countenance, though thinned, tremulous, with the sharpened nostrils habitually moving at every breath, may have a clearness in it, with colour in the lips, and a brightness of the eye which are never seen in other serious diseases; and the frame of mind is often in the same unconscious and hopeful state, indicating a degree of freedom from those painful struggles in which the vital powers commonly contend with other serious disorders. Now, we apprehend the chief reason for this exemption from suffering lies in a sort of balance that is maintained among the injured functions. The available parts of the lungs are reduced to a great extent; but so is the mass of blood that has to pass through them. The free expectoration and the colliquative discharges from the skin and bowels are continually bringing down the bulk of the circulating fluids to the lessening capacity of the remaining lung. The night sweats, especially, are a periodic discharge of the amount of fluid which is beyond what the reduced system of bloodvessels can quietly hold; they often cease when the fluid ingesta are judiciously reduced. So the secondary pulmonary irritations, congestions, and inflammations are continually relieved by the purulent expectoration; it is a safety valve which gives vent to these local lesions before they cause much distress; and although the destructive process is perpetually proceeding, the lungs decaying, the body wasting, and the strength failing, yet it is all by even degrees, a *facilis descensus:* the thread of life dwindles away, fibre by fibre, without struggle or shock; and gentle is the parting of the last filament, when the body drops to earth and the soul rises to eternity.

But the progress of consumptive disease is by no means generally thus painless and unharassed: the sufferings from dyspnœa, cough, pain, chills, heat, and feelings of extreme weakness and faintness, are sometimes very severe. In some persons, the animal sensibility is more acute than the organic life is active; to such, any disorder is distressing; and even in consumption, the cough, the pains in the chest, side, or shoulders, the alternate

chills and heats, the oppression of dyspnœa, the languor and faintness of debility, besides various pains and aches in different parts of the body, are perpetual sources of complaint. But without any unusual sensibility in the subject, the course of consumptive disease may be rendered rough and painful by what may be called the accidental or accessory lesions contingent upon it. Intercurrent congestions, hæmorrhages, and inflammations taking place in the lungs or in their investing membranes, are very common, and may give rise to the symptoms of these several acute lesions superadded to those of phthisis. Hence the increase of cough, dyspnœa, and fever, occasionally with pain, in case of bronchitis, pneumonia, or pleurisy, occurring in the course of the disease; and hæmoptysis, with the faintness and other effects of loss of blood, if this be considerable, or with greatly increased oppression if the effusion is more confined to the tissue of lungs. We can confirm the observation of Dr. Stokes, that free expectoration tends to prevent these accidental complications; and accordingly their occurrence is often preceded or accompanied by a suppression of this discharge, or an alteration in its quantity. But there is an accident which especially tends to ruffle and hasten the course even of the most latent forms of consumptive disease; this is perforation of the pleura, and the consequent pneumothorax and acute pleurisy which it produces. As we have already described this lesion and its symptoms, we need here only remark how characteristic the sudden increase of dyspnœa and cough and accession of sharp pleuritic pain must be in the cases that were before most insidious, and how much the addition of these lesions must increase the distress of the patient, and hurry him towards his grave. Spontaneous perforation of the pleura seems to occur chiefly where the constitution is decidediy tuberculous; and it implies a want of that self-preserving energy by which the mischief of ulceration is bounded by the timely effusion of plastic lymph. This is a part of the nutrient function; and perhaps it is because this function is more active in women than in men, that perforation of the lung is comparatively rare in females. Such, at least, is the result of our experience, not having met with one instance in about thirty cases of this complicated lesion that have fallen under our observation; and there are very few instances recorded by others of its occurrence in females. In a few instances. the perforation appears to have been the result of adhesions partially attaching the lung to the walls of the chest, and thus exposing it, in case of external violence or internal pressure, to a lacerating force, as noticed under the head pneumothorax.

Other symptoms unconnected with the chest frequently attend pulmonary consumption. The larynx is very often the seat of disease, and hoarseness or loss of voice is frequently an early symptom, sometimes taking attention from the seat of the more important lesion. It appears from the researches of MM Trousseau and Belloc, that ulceration and other structural disease of the larynx do sometimes occur when there are no tubercles in the lungs; but these are very rare cases, and in by far the majority of instances these lesions are associated with tuberculous disease of the lungs, and perhaps in all are connected with a tuberculous constitution. Dr. Stokes considers this complication to be universally fatal; but it is not always speedily so, for we know at present three instances in persons now alive of its having lasted from five to eight years.

The disorder of the digestive organs, which, in the earliest and irritative stage of the disease, had something of the gastritic character, with red-tipped tongue, thirst, sometimes pain or oppression after eating, occasionally tenderness of the epigastrium and other symptoms of indigestion, generally passes away as the pulmonary irritation is relieved by the discharge. In a few instances, occasional severe pain of the stomach, and vomiting, continue to the fatal termination, greatly adding to the distress and weakness of the patient. In most instances, sooner or later, the bowels become disordered; constipation and diarrhœa alternately prevail, dependent on inflammation and

ulceration, often complicated with tuberculous deposition in the follicular structure of the mucous membrane of the intestines. The mesenteric glands frequently become involved in the same disease, particularly in young subjects; and thus arise additional causes of exhaustion and atrophy, in the colliquative discharges and obstruction to nutrition that ensue. There is often but little pain with all these serious lesions. The alvine secretions sometimes show a deficiency of bile; but this is a symptom which more frequently precedes phthisis than accompanies it. Sometimes there are great tenderness and even pain in the abdomen during the whole course of the disease, with occasional exacerbations: these symptoms generally depend on granular or tuberculous depositions on the peritoneum, combined occasionally with inflammation of the membrane, which may lead to the agglutination together of the folds of the intestines.

More rarely, tubercles occur in the brain or spinal marrow, or their membranes, and cause symptoms of mental disorder, convulsions, or paralysis. Acute hydrocephalus seems to have some connection with scrofulous or tuberculous disease further than what can be traced to the existence of tubercles in the encephalon; for it sometimes coexists with tuberculous disease in other parts, when none can be detected in the brain. The catamenia, in females, are generally defective, or absent, at an early stage of consumptive disease; but they are not so constantly so as Laennec supposed. Their suppression is, on many accounts, an unfavourable sign. We have not space to dwell on the details of other symptoms arising from the irritations or obstructions, the weakness or the wasting, which tuberculous consumption brings in its train. The emaciation in the last stages is very great, especially in the less acute cases; yet it is surpassed by that from scirrhus of the stomach, and tabes mesenterica. There is a blanching with the emaciation, which is more remarkable than its degree; the bloodvessels are reduced, as well as other textures; hence it is rare in tuberculous consumption to see the redness of the knuckles, and distinctness of the veins of the hands, which accompany even greater degrees of emaciation from chronic diseases of the abdomen.

Physical signs. We proceed to trace the physical signs in the different stages of the textural lesions which we have described as the essential causes of pulmonary consumption.

First stage. In proportion as the indurations which characterise the first stage are of great or small amount, and are concentrated within a small space, or scattered widely through the lung, they will produce more or less appreciable signs. Thus, the miliary indurations, even in considerable number, may be scattered through the tissue of the lung without producing any distinct diminution or change in the respiratory sound, or in the resonance of the chest on percussion. Sometimes there is a general submucous or subcrepitant rhonchus; but this proceeds less from the tubercles than from the secretion which their irritation causes in the bronchial tubes: it is the sign of a partial bronchitis or bronchorrhœa, therefore, and can be taken in evidence of the probable presence of tubercles, only when it continues permanently, or recurs in the same places day after day, instead of tending to become sibilant, and to cease, as the rhonchi of common bronchitis do. But it seldom happens that even the early indurations are equally scattered through both lungs. Their tendency is to accumulate in greater numbers in little clusters near the apices of the lungs, and generally more on one side than on the other. Here there will be a concentration of their effect, and an inequality between the two sides of the chest; and on exploring the corresponding regions outside, which are the clavicles and the space below them, and the upper ridge of the scapulæ, we may find differences in the sound on percussion, or those of respiration, and the voice, which, according to known principles, may be interpreted as signs. The clavicle on one side, when lightly struck downwards on its centre, yields a sound duller than that on the other; and especially if this difference extends to the other parts just mentioned, it is exceedingly probable that there is consolid-

ation of the lung in that part. Great care must be taken to strike both clavicles at the same point, or both infra-clavian spaces in the same mode, or the comparison will not be a fair one. To avoid error, the parts should be quite uncovered; and various kinds of percussion should be tried in doubtful cases, as tapping with a single finger, and with the flat of several fingers, and in different stages of the respiratory act, on a full breath, and after exhausting the lungs. Sometimes the gentlest possible patting of the subclavian spaces is the only mode in which any difference can be discovered. In the posterior region, and on the scapular ridge, strong mediate percussion with the finger is necessary to elicit any sound, comparison being made, as usual, of the sounds on the two sides. Differences in the sounds are to be sought where differences ought not to exist; and although the mode and force of percussion should be varied at different times, they should be carefully the same in each act of comparison. Between the scapulæ is not an unfrequent seat of dulness, especially in children, where the disease occupies the bronchial glands.

The eyes should likewise be used to scrutinise the motions of the chest, when the patient is placed in a good light opposite to the observer, and is desired to take a full breath several times. It requires more consolidation than is common in the more doubtful stages of the disease, to produce any considerable irregularity in the shape or motions of the chest; but we can often perceive a slight difference between the two sides; the upper ribs do not move quite so much on one side as on the other.

The stethoscopic signs are more delicate, and, perhaps, more equivocal, than those of percussion. The indurations may form slight partial obstructions to the passage of air, and thus cause a permanent slight wheezing, whistling, or roughness in the respiratory sound, not removed by full inspiration or cough. If more numerous or extensive, they may transmit the sound of whiffing or bronchial breathing in parts where naturally the vesicular only is heard, whilst the soft vesicular breathing is impaired in its force. The sound of expiration may become unusually audible, so as nearly or quite to equal that of the inspiration, which naturally is almost the only sound heard in pure vesicular respiration. When, as it often happens, the partial indurations are accompanied by a dilated or emphysematous state of the neighbouring air-cells, the sound of percussion will be less changed than usual; but the breathing will be more whiffing, or more obscure, according as the dilated cells are more flaccid or more rigid than usual. The sound of the voice is transmitted by the indurations in an unusual degree; sometimes only in a diffused resonance; sometimes in a more circumscribed vocal note, but without the articulation of the oral voice. So also below the clavicles, the sounds are sometimes transmitted with unusual clearness from the subjacent arteries, being either double from those of the heart, or single from the mere impulse; and occasionally the single pulse is accompanied by a whizzing or blowing confined to the part, which, probably, indicates a partial obstruction of the subclavian arteries by the pressure of indurations at the apex of the lung. This has been noticed by Dr. Stokes as a sign of incipient phthisis. It is not to be depended on, as such a murmur is not uncommonly induced in some healthy subjects under slight excitement, probably from the artery pressing on the clavicle or upper rib. It often intermits, being confined to certain stages of the respiratory movements.

All the stethoscopic signs derive their importance directly from the situation in which they are heard, and from their comparison with the sounds of other parts. There are often natural bronchophony and bronchial respiration near the sternum, between the scapulæ, and in the axillæ: such signs in these parts, therefore, are not to be considered morbid, unless they be either much more distinct on one side than on the other, or accompanied by dullness on percussion. They may be better trusted towards the humeral end of the clavicle: the angle formed by this bone and the shoulder is the proper stethoscopic corner, and the signs heard there, and at the humeral portion of the scapular ridge, are the most unequivocal; but even here a permanent discrepancy between

the two sides gives the surest indication of disease, for the natural sounds present some variety. It is also necessary to bear in mind that the vocal resonance is often slightly louder on the right than on the left side. In the early stage of numerous diffused granulations, there is sometimes dulness on percussion with obscure or submucous respiration in the lower dorsal regions of the chest, probably dependent on congestion of the pulmonary plexus of vessels in these parts.

Besides the more direct physical signs of the indurations, the mucous or submucous rhonchus caused by the secretion of the bronchial tubes, may render their existence probable when it continues long, or returns frequently to the same part. This observation was first made by Dr. Stokes, who has well remarked that this symptomatic bronchitis differs from simple bronchitis in being first circumscribed and confined to the upper lobes, whence it may spread downwards; but before it reaches the middle and lower lobes, the common seat of ordinary bronchitis, the tubercles in the upper become manifest by various obvious signs.

The diagnosis of the early stage of phthisis is often a matter of extreme difficulty; depending, as it does, on a proper consideration of the general symptoms, as well as on a careful examination and interpretation of the physical signs, it cannot be mastered without considerable experience as well as tact on the part of the observer.

Second stage. The conversion of the semitransparent, grey, or dark consolidation of the lung into yellow tubercle is a point only deduced from anatomical examinations, for there are no certain signs of this change during life. There is sometimes an abatement of the more irritative symptoms during this change, and at the same time an increased expectoration, and the submucous and mucous rhonchi become more marked. But the change to yellow tubercle can scarcely take place without some augmentation of the consolidation; the indurations increase in extent, and some yellow tubercle is sometimes deposited in other parts. Hence there is often a fuller development of the signs of an increased density of the lung; the partial dulness on percussion becomes more marked; the respiration becomes more obscure or more bronchial, and it may be accompanied by a permanent fine crepitation. The vocal resonance may also increase in degree and extent, and altogether the signs become more localised, and therefore less equivocal. These, taken with the change in the general symptoms before described, may be taken in evidence that the consolidations have become more or less tuberculous.

Third stage. But the softening and evacuation of tuberculous matter, produce the most remarkable and cognisable changes in the physical signs; and these also often give to the expectoration something of the precision of a physical sign. The sputa before may have been sometimes opaque and mucopurulent, as in bronchitis; but they now become decidedly purulent, often sink in water, and, if narrowly examined, may sometimes be found to contain particles of a curdy or clotted matter, like cheese softened in water, which is tuberculous; it is not fœtid like the similar concretions from the tonsils. There may also be little streaks or even clots of blood; but this is uncertain. There is generally, besides, more or less mucus, which gives tenacity to parts of the expectorated matter; but on close examination, it may often be seen that some sputa are opaque purulent clots, almost without mucus; it is these which come directly from the cavities. In whatever part of the chest these changes take place, generally under one of the clavicles, or above the spine of one of the scapulæ, there may be heard a clicking or bubbling sound, which is coarser, and gives the idea of being produced in a larger space than any of the common sounds of these parts. This sign is the more conclusive, the finer and more completely vesicular is the natural structure of the lung in the part in which it is best heard. In listening for it the patient should be desired to cough or to take a full inspiration; when at first there may be heard only one or two clicks from the entry of single bubbles: but as the evacuation of the softened

matter proceeds, and there is more room for the entrance of air, there is then a more continued bubbling or gurgling sound, and this will be coarse and distinct in proportion to the extent of the vomica and its communication with the air-tubes. This gurgling or *cavernous rhonchus* will also somewhat vary according to the quantity and liquidity of the contents of the cavity, becoming less crackling and more whiffing as these diminish. When it is heard over an extended space, there are probably several cavities communicating with each other, and all containing more or less liquid. It may present other varieties, which are quite intelligible when the mode of its production is known.

The softening and evacuation of the vomica being complete or nearly so, there is left an ulcerous cavity or cavern, which becomes the seat of further phenomena. Even before all the liquid is evacuated, we sometimes hear, in the corresponding part of the chest, with the gurgling, a hollow whiffing or blowing sound; and when the patient speaks, a sort of *snuffling* voice interrupted, broken up by the gurgling. When the cavern is empty, these pass into *cavernous respiration* and *pectoriloquy*. Cavernous respiration resembles that heard on listening with the stethoscope to the front of the neck over the windpipe; but it is more circumscribed, and does not give the same impression of a rush of air. It may better be imitated by blowing into shells or thimbles of different sizes. It may present considerable variety, according to the size and shape of the cavity, and the freedom with which the air passes into and out of it from the bronchi. When of very large extent, the sound becomes amphoric, like that produced by blowing into an empty phial, and precisely on the same principle. All these phenomena are best obtained with quick forcible respiration or slight coughing, which increases the force and velocity of the passing air, and exaggerates the sounds.

Pectoriloquy is another very striking sign of a cavity in the lungs. Its value was perhaps overrated by Laennec; but we think that it has been neither appreciated nor understood by subsequent writers. We formerly explained that the voice, although formed in the larynx, vibrates in full strength, through the windpipe and its branches, until it becomes broken up and muffled in the smaller tubes and soft porous tissue of the lung. But if a cavity be formed in this parenchyma, communicating freely with the tubes in which the voice is strong, it will form a part of those tubes, and the vibrations will be continued *in system* from them to it; and there may thus be heard near the surface of the lung, a voice from the chest like that heard over the trachea, — its distinctness and intensity being more or less perfect, according as the cavity is adapted to receive the vocal resonance from the tubes, and to transmit it to the walls of the chest. Laennec made an artificial distinction between the degrees of pectoriloquy, according to whether the voice does or does not give to the ear the impression of passing up the stethoscope when the stopper is in. In the *perfect* kind the words are so distinct that it seems as if the patient had his mouth to the tube: where this impression is not produced, the pectoriloquy is *imperfect*. But this is only a difference of degree, and of doubtful importance. We consider the character of the sound and its circumscribed position a more serviceable distinction. The sound is not a mere vocal resonance, like the bronchophony from consolidation, which is often as loud or louder, and may seem to pass up the tube quite as much; but it is an articulate although indistinct speaking, and sometimes accompanies a loud whisper as well as vocal utterance. There is in it another feature which is characteristic, and distinguishes it from bronchophony; it is accompanied or followed either by whiffs of cavernous respiration, which give the pectoriloquy a snuffling character, or by a hollow or fistular resonance, like that produced on speaking at the orifice of the tube of a Pan-pipe, the pipe of a large key, a shell, or any such hollow body. This accompaniment is sometimes heard when the pectoriloquy or the transmission of the articulate voice is very imperfect: but we have found it to be more distinctive of a cavity than the loudest vocal sound without it. It may be supposed to depend on the same physical cause as that of the similar sound

in the hollow bodies to which we have compared it; the cavity in the lungs being in the same relation to the bronchial voice, as they are to the oral voice. When the cavity is large, the resonance is more amphoric or bottle-like; and if the communication with the bronchi be at the same time narrow, the voice may be scarcely transmitted to it, but excites in it only a tinkling echo — a metallic tinkling, as in pneumothorax. All these hollow, fistular, or tinkling characters may be also perceived in the breathing and cough, especially in the latter, but not in a proportionate degree, and sometimes are only perceptible with the voice. These differences must depend on the relations of the cavity to the air-tubes communicating with it: if this open into them so as to catch the current of air passing through them, its interior will be thrown into vibrations; otherwise the air in the cavity may only receive the stronger and more pervading vibrations of the voice. So also, if there be much consolidation about and beyond the cavity, there may be very little passage of air in the tubes, and therefore but little cavernous breathing.

The circumscription of pectoriloquy is another of its peculiar characters, and by this it may generally be distinguished from the loud bronchophony of condensed lungs, which is diffused over some extent of surface. To observe this difference, it is necessary to limit the point of examination, by using the stopper in the stethoscope. By this mode we can trace the precise boundaries of the pectoriloquy of a cavity; but when we try to trace where the resonance of the bronchophony ceases, we find no exact limits; it gradually loses force as the tubes become smaller, or the superjacent lung more porous. Pectoriloquy is most characteristic when it forms a *little island* of voice under a clavicle, and little or no sound is transmitted nearer the sternum. The pectoriloquous bronchophony of a lung consolidated by inflammation, or compressed against the walls of the chest by a liquid effusion, never has this isolated character, but is generally louder in proportion to the size of the tubes involved in the condensation. It is however true, that sometimes the pectoriloquy of phthisis is not circumscribed; for besides the cavities, there may be extensive consolidation of the lung, and consequently free transmission of the voice over an extent of surface. Even in this case a practised auscultator can distinguish the peculiar phenomena of cavities, in the snuffling, blowing, or tinkling, and the more articulate voice that certain spots present, or in a coarser gurgling if there be liquid. It is obvious that all these phenomena are liable to be interrupted or modified by the accumulation of the matter secreted by the cavities and adjoining tubes; and that, after cough and expectoration, a spot that before gave no sound in common breathing, and gurgling on forced breathing, yields the cavernous breathing and pectoriloquy. So also, as in time the disease advances, the excavations become extended, and the gurgling first, and the pectoriloquy afterwards, are heard in new spots.

Although, after the excavation of tubercles, there is more air in the chest, yet the sound on percussion generally remains dull, for there is much solid deposit about the walls of the cavities, and the irregular density and flaccidity of the parts, as well as the defect of air in the peripheral structure of the lung, still tend to check and to muffle the vibrations of the walls of the chest, and prevent them from yielding a clear sound. Even where the cavity is so large as to be the seat of a tinkling echo, the resonance on percussion is irregular and imperfect; and thus may this case of metallic tinkling be distinguished from that of pneumothorax, in which some part of the chest must have an unnaturally clear sound. Sometimes the percussion is clearer in consequence of a general dilatation of the superficial cells; and as this is commonly of the flaccid kind, it may be accompanied by a sharp puerile kind of respiratory sound: both these circumstances may disguise the phthisical signs, but only partially, for there will still be some decided irregularities in the sound of percussion, and enough of the signs of the subjacent cavities to declare the case to the wary observer. Occasionally a hollow or bottle-like sound is produced by percussion over a cavity; this is when its walls are pretty dense, and it communicates freely with

the bronchi. More commonly there is an opposite condition: the walls of the cavity are loose and yielding; and if it be large, percussion may sometimes cause a motion of its contents, and a gurgling or tinkling expulsion of air from it, which gives a muffled metallic sound, like that of money in the nearly closed hands, or more like the imitation of that noise which may be made by striking the hands hollow and closed, upon the knee. Laennec compared the sound to that emitted by a cracked jar when it is struck.

With the irregular and deficient sound on percussion, generally most evident under the clavicles or in other parts of the upper regions of the chest, there is very commonly associated a collapse or sinking in of the walls of the chest, forming below the clavicles a hollow, generally more conspicuous on one side than on the other. There is very commonly, also, some defect and irregularity in the movements of the chest, the upper ribs of one side being but little raised, and the lower parts altogether exhibiting the most motion. But there is rarely that complete fixing of the side that we see in chronic pleurisy, in which case, too, the upper part is generally more mobile than the lower.

We might class with the physical signs the characters of the sputa in the third stage of consumption, if they came only from the cavities which are peculiar to it. The expectoration of distinct portions of tubercle, or of pulmonary tissue, which are seen in a few cases, constitutes a physical sign of the clearest character; they must come from cavities. If patients could save all their expectoration, and this were inspected daily, this unequivocal sign might be more frequently met with. But the inflamed air-tubes are in great measure the source of the expectorated matter, which therefore presents much of the same aspect as in chronic bronchitis. The large size, and almost perfectly purulent character of the masses sometimes expectorated, which are like irregular balls of flock or wool of a yellow or greenish colour, sinking and breaking down in water, go far to prove the existence of cavities in the lungs. These have been particularly noticed by Dr. Forbes. A dirty yellowish brown or greenish matter, occasionally fringed or streaked with blood, flattening like a piece of money when separate, and in masses forming a smooth sluggish purilage, are more characteristic of phthisis, and generally occur in the most advanced stage. The general pulmonary congestion which frequently precedes death, is often announced by the darker reddish or green hue of the purulent sputa. Profuse hæmoptysis does not often occur in the advanced stages of consumption; for the vessels soon become plugged with fibrin, and obliterated in the diseased portions of lung, and the mass of blood is reduced to the capacity of those that remain free.

Complications. It is very common for phthisis to become complicated with other diseases of the chest, particularly bronchitis, pneumonia, and pleurisy; and the attacks of these additional lesions sometimes prove fatal, even when the phthisical changes are not extensive. Partial bronchitis is an almost constant concomitant of tuberculous disease of the lung; but more general attacks also sometimes occur from the ordinary causes, such as exposure to cold, the epidemic prevalence of influenza, and febrile diseases: they then bear a character more formidable than usual, being themselves less tractable, and may cause suffocation; or they may accelerate the progress of the phthisical disease. It is also very common to find general pneumonia attacking a lung in which there are miliary tubercles, which must have existed prior to the inflammation, and would probably not have run their course for several months. This complication greatly increases the danger of the pneumonia also, which, unless it be stopped at its very onset, generally proves fatal. In some instances, especially in the young, we find a reason for the intractability of such a pneumonia, in the tuberculous character of the hepatisation, which has the greyish or boiled-liver aspect, with considerable softening, instead of the redder deposit of common hepatisation; on the pleura there is sometimes seen, at the same time, an opaque friable lymph which borders closely on real tuberculous matter. In other instances, where the disease has not advanced far enough to present

these appearances, we can still understand that there may be in the deposit enough of that defect of vitality, which renders tuberculous matter so difficult of absorption. The supervention of the signs of an extensive pneumonia, crepitation with increasing dulness on percussion, affecting the posterior lobes of one or both lungs, together with the increased heat, febrile disturbance, and the rusty tinge of the sputa, must be looked on as indicative of extreme danger to patients with any extent of phthisical disease; for if it do not itself prove fatal, as it commonly does, the inflammatory attack will not fail to hasten and increase the phthisical disease. It is different with the circumscribed pneumonia, which sometimes attacks portions of lung in the progress of tuberculous disease: these come on without much disturbance, and subside without causing much mischief, being probably the result of mere local obstruction or irritation. The same remark applies to the slight pleuritic attacks, which are very common in phthisis; the effects of which are seen in the adhesions of the pleura, so generally found in phthisical subjects. We have repeatedly heard a sound of friction in a part of the chest which lasted for several days, and the chest after death exhibited adhesions at this point. Probably the inequalities occasioned by the deposits in the lung, as well as the textural irritation, cause these local inflammations of the pleura. They rarely produce much effusion, but soon terminate by adhesion. Liquid effusions do occasionally occur, from a more general cause of inflammation, such as the bursting of a vomica into the pleura. If the vomica also communicate with the bronchi, there will be pneumothorax as well as liquid effusion. In either case, the pleurisy is a serious and untractable addition to the consumptive disease, and may prove fatal in a few hours. Pulmonary hæmorrhage is another serious accident, most commonly occurring in the early stages of phthisis. It may prove fatal, by loss of blood, or by suffocation; or the effusion of blood may break up the tissue of the lung to a great extent, and the patient may sink from the sloughy suppuration which ensues; or, after the hæmorrhage has ceased, inflammation may arise in and about the hæmorrhagic consolidation, and involve the lung in a destructive suppuration, which may be more or less of a tuberculous character.

Varieties. The varieties which pulmonary consumption presents are very considerable, and even recent authors, such as Laennec, Clark, and Stokes, have thought several deserving a distinct consideration. Laennec recognises five: 1. Regular manifest phthisis; 2. Irregular manifest phthisis; 3. Latent phthisis; 4. Acute phthisis; 5. Chronic phthisis. Sir James Clark also notices five: 1. Acute; 2. Febrile; 3. Chronic; 4. Latent; 5. Infantile. Dr. Stokes specifies no less than six varieties of phthisis besides those diversified by complications: 1. Acute non-suppurative; 2. Acute suppurative; 3. Chronic progressive; 4. Chronic ulceration following pneumonia; 5. Tubercle consequent on chronic bronchitis; 6. Tubercle consequent on the cure of empyema. None of these divisions is sufficiently comprehensive to include all the varieties of pulmonary consumption, which may take a peculiar stamp from the nature of its causes; from the constitution of the subject; from the predominance of particular symptoms, such as those of irritation or those of colliquative secretion and decay; from the extent and progress of the local lesions of the lungs; and from the complications with lesions of other organs. It is highly important to observe these differences in relation to the diagnosis, prognosis, and treatment of individual cases; but to describe them all as distinct varieties would lead to needless refinement and prolixity. It will be sufficient for our purpose to distinguish two kinds of consumption, the *acute* and the *chronic*, without however professing that the line between them is always well marked, and admitting that each may present considerable variety in its predominant symptoms.

Acute or rapid Phthisis. Sir J. Clark states, from collating the observations of Heberden, Bayle, Andral, and Louis, that the average duration of consumption ranges from nine months to two years; in the acute form it may prove fatal, in from three weeks to two or three months. In some of such

cases the symptoms and stages do not differ from those already described, but they are unusually severe and rapid in their course; emaciation does not proceed so far; and the physical signs during life, as well as the examination after death, show that the extensive tuberculous deposit, and the consequent lesions of the lung, have been the sufficient cause of this rapid progress. This is what is popularly called "galloping consumption;" it commonly occurs in very scrofulous constitutions, particularly in young subjects, and is often developed by an attack of inflammation of the lungs or their membranes. In other cases, miliary tubercles are developed in such great numbers, that they prove fatal in their first stage, few of them having suppurated. In such instances there is generally a predominance of the signs of irritation and obstruction; dyspnœa; frequent cough, with little or only bronchitic expectoration; much fever and quickness of pulse; frequently palpitation; sometimes hæmoptysis; and the disease may prove fatal in from three weeks to two months, often without considerable emaciation, but with increasing oppression to the function of respiration. The lungs are found thickly studded with miliary tubercles, or with numerous nodules of tuberculous consolidation of a grey or a drab colour and moderate consistence, none of which have become excavated, except perhaps in the upper parts of the lungs, where a few have become soft and have formed small vomicæ. The intermediate tissue is sometimes in the first stage of inflammation; sometimes it is unaffected or partially emphysematous. The bronchi are almost always inflamed, and filled with a spumous mucus; and not unfrequently they are partially dilated. This non-suppurative variety of acute phthisis is noticed by Dr. Stokes as usually succeeding to fever, particularly that of a typhoid kind. From the general prevalence of fever throughout its course, Sir J. Clark terms it *febrile phthisis*; but he does not sufficiently distinguish it from his other acute variety, in which the tuberculous changes are more complete, and in which the tuberculous deposition is often in the infiltrated or diffused form. From the general symptoms, this form of acute phthisis is liable to be mistaken for bronchitis or pneumonia, and it is only by attention to the physical signs, as well as the progress of the whole case, that the distinction can be made. Of this we shall speak under the head *Diagnosis*.

Chronic Phthisis. Tuberculous consumption is in its ordinary career a chronic disease; but the cases that especially deserve this title, are those in which the disease lasts for many years. Bayle and Laennec record instances in which patients appear to have had the disease thirty and forty years. But it is not to be supposed that in chronic cases, the disease is always progressive. It owes its long duration to its limited extent; and although the lungs are never free from some of the lesions described as characteristic of phthisis, yet the continuance of the disease is chiefly marked by many successive attacks and partial recoveries, dependent on the partial development of new tubercles and their successive changes and elimination. As the rapid form of the disease occurs chiefly in young subjects, so this in most instances is met with at or after middle age; but it is by no means confined to any period of life. In many instances it wears the garb of a common pectoral catarrh, recurring frequently in cold weather, and in great measure subsiding during the warm season; but on attentive observation it will be found that the attacks, although in great measure bronchitic, are attended with more purulent expectoration, hectic fever, and loss of flesh than those of simple bronchitis, and that the cough is never entirely removed, and the patient rarely quite recovers his flesh and strength. He may return to his usual pursuits, and consider himself recovered, but he is somewhat short-breathed, and suffers from any unusual exertion, which may sometimes induce hæmoptysis. With the return of winter the pectoral symptoms recur, to be again alleviated or removed in the summer, until at last one attack, more severe than the rest, proves fatal, or the disease makes more rapid and decisive progress in consequence of the failure of the constitution or the spread of the local disease. The physical examination of

such cases, even at an early period, generally furnishes pretty clear evidence of the existence of phthisical lesions; for although these are limited in extent, they produce signs the more contrasted with those of the healthy parts of the lung. Hence under a clavicle, at a scapular ridge, or in some circumscribed spot in the chest, there are dulness on percussion, deficient or bronchial respiration, and undue resonance of the voice, or, as the disease advances, the different signs of a cavity before described. In such cases the long continuance or frequent recurrence of bronchial rhonchi in one particular spot, affords, as Dr. Stokes has observed, strong presumptive proof that tubercles are there irritating and pressing on the air-tubes. It is this chronic or limited form of tuberculous disease that affords the best chance for the remedial powers of nature and art; and there can be little doubt that a considerable number of cases are cured. The lungs of those who have died of chronic phthisis present appearances that can be distinctly referred to different dates. In the upper parts there are often old cavities lined with a false membrane with hard black tissue around them, the exterior of the lung being irregularly puckered and nodulated by the indurations, the contraction of false membranes, and the emphysematous distension of the uncondensed texture. The old date of these changes is plain from their hardness, and grey colour, and the complete organisation of the false membranes lining the cavities, or uniting their sides. Near the same parts, but more abundantly in the middle and lower parts of the lung, there may be cavities of more recent formation, with their walls comparatively soft, ragged, or imperfectly lined by albuminous matter; and there may be likewise more or less of the different kinds of consolidation — circumscribed and diffused, grey, red, and dark-coloured, — which constitute the earlier stage of phthisical lesions, in parts generally exhibiting the changes into crude and soft tubercle. It is sometimes not difficult to recognise, in these different appearances, the lesions which have been connected with the several successive attacks which the history of the patient records. Laennec adverts to these successive productions of tuberculous disease, which he calls *crops* of tubercles.

But many of those affected with chronic phthisis, or circumscribed tubercle of the lung, die sometimes from other diseases connected with this lesion, such as hæmoptysis, pneumonia, bronchitis, pleurisy, perforation of the pleura; sometimes from causes unconnected with it, such as fevers, inflammations of other viscera, accidents, &c. These cases give us the opportunity of seeing consumptive disease in its slighter forms; and they are so common beyond middle age as to have been met with in more than half the cases in which we have thoroughly examined the lungs of subjects who have died of various diseases in London and Paris. It is easy to discover these partial lesions, on feeling the lungs between the fingers, and cutting into any resisting or indurated portion, which will be found to be a grey or red induration, a yellow or cretaceous tubercle or the remains of one, a smooth cavity or a cicatrix, to which may sometimes be traced obliterated bronchial tubes. In a few instances we have met with cavities of considerable extent, without any remains of tubercle, the walls only being composed of condensed pulmonary tissue, smoothly lined by a false membrane, which sometimes is opaque, fibrous, and rather thick, and sometimes as thin as mucous membrane. We shall presently revert to these facts as proving that phthisical lesions are generally destructive, on account rather of their extent and constitutional origin than of their nature.

Laennec and several subsequent writers have treated of *latent* phthisis as a distinct variety: but seeing that the cases falling under this denomination differ from the common, the acute, or the chronic forms of consumption, only in their general symptoms being less marked than usual, or being disguised by the symptoms of various other affections with which the disease is complicated, it does not seem correct to separate them into a distinct variety. But it is highly important to know that all the varieties of phthisis may present very different degrees of prominence in the usual symptoms, and that they may be masked, even to their last stages, by affections of other organs, particularly of the

stomach, intestines, and liver, and by various fevers, as well as by previously existing or concomitant affections of the respiratory apparatus, especially bronchitis, laryngitis, pleurisy, and pneumonia. In all these cases the physical signs will generally furnish the means of diagnosis: but in many instances the general symptoms likewise, if attentively studied, will indicate the nature of the disease; and it is from inadvertency on the part of medical men, and from their preconceived notions and those of the patients, as much as from the obscurity of the symptoms, that phthisis is so frequently overlooked. We think it necessary to warn the young practitioner not to conclude that a cough is merely a "stomach cough," a "liver cough," or an "hysterical cough," because there is marked disorder of the corresponding organs, nor that shortness of breath and night sweats proceed from general debility; nor that symptoms are not phthisical because the patient has long suffered from pulmonary catarrh or chronic laryngitis, until he has found, on repeated examination, no physical signs of phthisis in the chest.

Origin and causes. If we attend to the history of different cases of pulmonary consumption, we shall find that they may be classed in three groups. 1. Those in which the individuals had enjoyed very good health until they were attacked with one or more severe colds, or inflammations of the chest, or a fever accompanied by pectoral symptoms, sooner or later after which the phthisical disease commenced. 2. In other cases, again, the cough and other symptoms begin very gradually, without any very obvious cause, and, with as little apparent external reason, soon increase to a serious extent, and the consumption runs a more or less rapid career. 3. In a third class of cases, the patients have been out of health, in a debilitated or cachectic state before the commencement of the cough and other local symptoms, which become developed after exposure to cold, the stoppage of an habitual evacuation, or some other cause likely to occasion local irritation or plethora.

1. In the first class of cases we have the development of phthisis from local inflammation or irritation without any evidence of prior constitutional disorder, unless an hereditary predisposition, which may be traced in some of these cases, may be considered as such. The acute inflammation, whether pulmonic, pleuritic or bronchial, imperfectly treated and only partially subdued, passes into a chronic form, and either immediately develops phthisical indurations in the lungs, or by generally lowering the vital powers leads to their formation from perverted nutrition, or from the irritation of any fresh exciting cause. Under any of these circumstances, chronic inflammation, either by its own local effects, or by its depressing influence on the constitution, or by both combined, becomes a sufficient cause of pulmonary consumption. As it might be anticipated, consumptive disease arising in this way is often more limited in its extent, and manageable in its course, than that arising from a prior constitutional disorder. As the cause is more local, so the lesion is more confined to a part; and we see instances of it in the very partial indurations and other phthisical lesions, or the traces of them, which we have lately noticed as occurring frequently in the lungs of persons who have died of other complaints. The physical character of these lesions in many such cases clearly identifies them with those which in greater extent constitute chronic phthisical disease. Yet the same local causes that produced these limited or solitary tubercles may engender many; and the greater the number that the local cause thus develops, the more effect will it have on the constitution which in a manner takes on a disposition to evolve the new production; hence therefore, out of a local cause, such as a latent or neglected pneumonia, pleurisy, or peritonitis, may arise a general tuberculous disease, involving more or less the whole system. Among the local causes of consumption is to be reckoned the habitual inhalation of fine solid particles, which is contingent on certain occupations, such as those of needle pointers, dry grinders, stone-masons, miners, colliers, and such like. The lesions in these cases are, as might be anticipated, bronchial as well as parenchymatous; and it has been questioned whether the consolidation of the

lung which is found is really tuberculous; but seeing that it tends in the same manner to softening and the formation of vomicæ, that granular indurations and distinct yellow tubercle sometimes accompany it, and that the symptoms and signs are those of pulmonary consumption, we see no reason for distinguishing between them. The dependence of the disease, in these cases, on the mechanical irritation of the inhaled particles, is sufficiently proved by the fact that these particles have been found in considerable abundance in the indurated lung, particularly in the case of the Edinburgh stone masons and the workers in coal mines, the texture being in the latter case completely blackened by the coal dust. In the case of the steel-workers at Sheffield, described by Dr. Knight, the fork-grinders, which grind dry, do not reach thirty-two years of age, whilst the knife-grinders, who work on wet stones, generally live to forty or fifty. The workmen employed in making gun-flints in the quarries of St. Rock are said by MM. Benoiston de Châteauneuf and Clozier to be sooner or later attacked with pulmonary disease, generally tuberculous; and, however robust originally, few pass the age of forty. With such cases may be associated the results of the experiments of Saunders, Cruveilhier, and others, in which lesions resembling those of phthisis were produced in the lungs of animals after the injection of mercury into the air-tubes or bloodvessels. The inhalation of vegetable or animal dust or particles does not appear to be so injurious, except in the case of the feather-dressers, brushmakers, and flock-carders. According to M. Benoiston, the average mortality in the former from phthisis only amounts to $7\frac{1}{2}$ per cent. for males and $11\frac{1}{2}$ for females. The injurious character of these employments may be explained, when we consider the irritating character of particles of feathers and hair, and how little they can be softened or decomposed by the animal fluids. It has been maintained that the production of tuberculous disease in these different employments, is due as much to a bad state of the constitution induced by confinement, abuse of spirituous liquors, &c. as to the local irritation: we do not deny that this may have a share; but the greater influence of the perpetual local irritation is apparent from the fact, that in other occupations in which the confinement and habits are quite as bad, not one fourth so many die of consumption.

2, 3. We may well consider the second and third classes of cases together, for in both the disease has its root distinctly in a state of the constitution, and they are distinguished only by an occasional or local cause being obviously added in one class, and not in the other. Unfortunately these form the most numerous group of consumptive cases, and those over which, when once formed, medicine has but little control. The cachectic condition of the system which precedes the formation of tubercle, as well as the circumstances that seem to occasion it, fully correspond with the pathological views which we have taken of its nature. Imperfect nutrition, whether from deficient or improper food, or from a permanently disordered state of the digestive or assimilative organs; unhealthy air, whether from closeness, humidity, or impurities; long continued exposure to cold, as from insufficient clothing, where there is not enough vascular irritability to lead to inflammation; depressing passions, such as disappointed love, anxiety, or distress from reverses of fortune or other severe calamity; venereal excesses; repeated courses of mercury; profuse and very weakening discharges; adynamic fevers, and the atonic state that sometimes succeeds to exanthematous fevers; irregularities of the uterine function, especially those that lead to chlorosis; the sudden suppression of habitual discharges or of long established cutaneous eruptions; these singly or combined are the most common causes of the constitutional origin of tuberculous disease. They all tend to destroy the balance of the functions and diminish the tone of the system, and with it that rich fibrinous and vital condition of the blood, by which proper nutrition and the organic functions are sustained. The impoverished blood, defective in that vital albumen with which the tissues are fed and renewed, deposits in its stead a degraded matter, imperfectly or not at all organisable, like that resulting from the lower degrees of local irritation or

inflammation. The lungs, the lymphatic glands, and a few other organs, become the first seat of these deposits, because their textures are in fuller relation with the blood than those of other parts are; and if there be in these organs also a congestion, an irritation, or an inflammation, the deposition becomes more extensive and rapid in proportion: although the inflammation be acute, it may also produce organisable lymph, together with the degraded albumen, tubercle; so also we find, that according to the natural activity of the nutritive process will be the rapidity of the tuberculous deposition and the progress of the disease. In young persons nutrition is most active, so is consumption more commonly spontaneous and rapid; and at no period is this more manifest than between the ages of eighteen and twenty-five, when growth becomes completed, yet the vessels and their blood do not immediately lose their habit of deposition. This view also corresponds with the fact stated by Andral, Lombard, and others, that of young persons, consumption shows itself earliest in females, in whom growth is sooner completed than in males. But throughout the whole period of childhood and of youth, tuberculous disease is very common, and under the influence of the causes already enumerated, is more easily engendered than when nutrition is less active. From the tables collected in the work of Sir J. Clark it appears that more than one fourth of those who die from birth to puberty are affected with tuberculous disease. We can understand why this morbid nutritive activity, this disposition to deposit tuberculous matter, should be particularly shown in women after the completion of utero-gestation, and in persons on the speedy healing of large suppurating wounds—circumstances which, as long as they continue, are known often to suspend the progress of consumptive disease.

Our limits will not permit us to go into many further details respecting the causes of tuberculous disease or of the cachectic condition on which it depends. Sir James Clark lays much stress on abdominal plethora, or congested state of the portal system of bloodvessels, as the chief cause of this condition; and there are many facts which favour the opinion that congestions of various internal parts frequently precede the development of consumption; but it is a question whether we may not take a link higher in the chain of causes, and view defective or irregular action of some of the principal secreting organs, or of the capillary circulation in general, as the precursor of these congestions. Signs of such defective action occur in scrofulous constitutions more constantly than those of abdominal plethora, and are manifested in coldness of the extremities, blueness of the nails, flushing of the face, a dry harsh or a flabby state of the skin, relaxed throat, scanty and high-coloured urine, irregular bowels, uncertain appetite and variable strength. In many cases pulmonary consumption has been preceded by such a condition of the system, and in such instances the disease may begin very gradually without any very obvious exciting cause, or it may be suddenly developed by an inflammatory or febrile attack. It must however be confessed, that such a condition of the system is often met with without being followed by consumption; and not a few cases of consumption occur without appearing to be preceded by any such disorder of the health.

The hereditary origin of tuberculous disease is established by the concurrent testimony of almost all writers, and it may be considered one of its most fertile sources. Sir J. Clark says that it is transmitted more often to the younger than to the elder children of a consumptive family; and he believes that a deteriorated state of the health in the parent from any cause, such as gout, severe dyspepsia, cutaneous diseases, debility from disease or from age, may give rise to the scrofulous constitution in the offspring. The same writer has very judiciously remarked, that even in those not inheriting it, a disposition to tuberculous disease may be readily induced by bad nourishment, confinement in impure air, and neglect of cleanliness during the whole period of their growth, and more especially in early years. A child under such circumstances, although born in health and of robust parents, becomes pale and thin, with a

tumid abdomen and enlarged glands, and fetid evacuations; and unless speedily removed from these unfavourable circumstances, soon dies of some form of tuberculous disease. The same thing is observed of the lower animals: thus, the cows confined in close stables in towns, become tuberculous; and rabbits may be rendered so in the course of a few weeks, by keeping them in a close damp place, and giving them only poor food. Partly to the confinement must be ascribed the fact that many of the monkeys brought to this country die tuberculous; but the change of climate must also be considered a chief cause, for negroes who come to this country are especially liable to phthisis.

Phthisis prevails more in temperate than in hot or very cold countries. It is the cause of nearly a third of the mortality in London, and not much less in Paris; whilst in Russia and in the East Indies, it is far less prevalent. In the West Indies, however, it appears from the tables of Sir James Clark to be very destructive among the negro troops, where it constitutes one half of a large mortality; and in the East Indies a considerable number of Malays, Caffres, and Indians, fall victims to the disease, which constitutes from one eighteenth to one seventeenth of the mortality, while among the Europeans it does not cause one in 500 deaths.

Diagnosis. Having already entered pretty fully into the signs and symptoms of tubercles of the lungs, it will not be necessary to dwell long on the subject of diagnosis. In the greater number of instances the features of the disease, together with the physical signs, are quite distinctive; but it often happens that the early stages are rendered obscure by certain complications, and it becomes difficult to distinguish, whether, in addition to the more obvious disease, tubercles are present or not. These complications are chiefly bronchitis, pneumonia, and pleurisy, and the diagnosis is to be made between them combined with tubercle, and the same simple.

Acute phthisis often begins with the signs of general acute bronchitis, accompanied by much febrile irritation. But when tubercles are present, the sound on percussion is more or less impaired; in some parts of the chest the quickness of pulse is unusually great; there is more tendency to night perspirations than in simple bronchitis; and the symptoms, instead of reaching an acme and then declining, with a change in the expectoration and in the character of the rhonchi, continue, and even increase, whilst the patient daily loses strength and flesh. In the generality of cases, simple bronchitis prevails most in the middle and lower parts of the chest; that accompanying tubercles always extends to the upper, and often occupies these chiefly. The complication of tubercle with pneumonia, which is a very acute form of phthisis, may be generally distinguished from simple pneumonia, by its commonly occupying both lungs, and progressing from above downwards; from the less rapid increase of the consolidation, by the decidedly hectic form of the fever after the first few days; and by the early production of the signs of cavities, accompanied by copious purilaginous expectoration, and sometimes hæmoptysis; none of these signs are usual in simple pneumonia. To distinguish in a case of pleuritic effusion, whether tubercles are present or not, may be a matter of great difficulty. With regard to the compressed lung of the affected side nothing can be determined, and as there is no longer a standard of comparison for the sound side, absolute signs alone can be depended on, such as decided dulness, bronchial or cavernous breathing, or pectoriloquy under the clavicle, or a permanent mucous or subcrepitant rhonchus. In the entire absence of these, and when the respiration is clear and puerile throughout that side, and the general symptoms and the aspect of the patient is not tuberculous, it may be presumed that there are no tubercles.

We have before adverted to the difficulty of distinguishing between simple chronic bronchitis and that accompanying limited or early tuberculous disease; and we must refer to the description of the physical signs for the chief means of diagnosis. Without attention to the physical signs, chronic pleurisy is very liable to be confounded with phthisis; they never fail to furnish a diagnosis in

the much more complete dulness and absence of respiration in pleurisy, particularly in the lower part of the chest, on one side only; in the enlargement of this part and the smoothness of the intercostal depressions, which contrast strongly with their sunken condition in phthisis. When the effusion has been partly removed, and partial contraction of the chest taken place, although from the dilatation of the tubes there may be pectoriloquy and other signs of cavities, yet the alteration of shape affects the side more extensively than phthisis does, and a perfect dulness remains in the inferior parts, which is quite unlike the condition induced by phthisis. The different character of the expectoration also will form another ground of distinction. Dr. Stokes thinks that tubercles are not uncommonly produced during the absorption of an empyema, and mentions as their signs, the occurrence of symptoms of new pulmonary disease, with hectic, quickened pulse, an increasing dulness and signs of irritation under the clavicle or scapular ridge.

Phthisis is sometimes disguised by chronic laryngitis; the affection of the voice, character of the cough, and other symptoms directing attention exclusively to the larynx; but we have before remarked that extensive ulceration of the larynx is very commonly accompanied or succeeded by pulmonary tubercle; and on careful examination, the signs of this may generally be found under one or both clavicles by the respiration or by percussion, if not by the voice.

There is one kind of lesion which, even in its physical signs, is liable to be mistaken for tuberculous excavations; this is dilatation of the bronchi. This may be the seat of a coarse gurgling rhonchus, cavernous breathing, and pectoriloquy; and the accompanying chronic bronchitis often causes also purulent expectoration. The situation, greater extent, and more stationary character of these lesions may serve to distinguish them: they most commonly occupy the scapular, mammary, and lateral regions, and not the infraclavian: they usually extend over a considerable space, but do not tend to spread as tuberculous cavities do. Again, if they arise from disease in the bronchi only, they do not impair the sound on percussion so much as phthisis does; and if they originate in pleuro-pneumonia, the dulness is much more complete, is confined to one side, and is accompanied by a more marked contraction than that which occurs in phthisis. But the general symptoms should also be taken into account. There is seldom with dilated bronchi the degree of hectic emaciation which occurs in phthisis; and when they arise from condensation of the lung, there are often œdema and general dropsy, which are not common in simple phthisis.

Prognosis. In a disease which causes so large a proportion of the mortality of the human race, it may well be supposed that the prognosis is generally most unfavourable: until Laennec discovered sure means of detecting tuberculous lesions, and also proved by anatomical researches that they are sometimes cured by a natural process, it was generally believed that they were quite incurable, and must sooner or later prove fatal. In making these discoveries, Laennec altered the state of our knowledge, chiefly by showing those to be cases of consumption which were formerly not admitted to be such, simply because they recovered. After the diagnosis has been distinctly made by aid of the physical signs, and the disease proved to be tuberculous, the prognosis is to be formed chiefly through the general symptoms. The extent of the pulmonary lesion may, indeed, only be determined by the physical signs, the dulness of percussion and respiration, the rhonchi, resonance of the voice, and signs of excavation, whether they are confined to a small space or extend to a considerable portion of both lungs; and, in the latter case, the rapid progress of the disease to a fatal termination may be at once prognosticated. But where, as is often the case, the physical signs establish the presence rather than the amount of the disease, we must refer to the state of the general health, to determine the probable time during which the constitutional strength may struggle against the disease, and the chance, if there be any, that it may get rid of it. When the cough

and dyspnœa are distressing, with copious purulent expectoration; the pulse constantly quick; the accessions of hectic severe, with or without night sweats; the loss of strength and flesh considerable and progressive,—no hope can be entertained with regard to the result, which will terminate unfavourably in a short time. When the dyspnœa is considerable, death generally takes place before the emaciation is extreme; and this is commonly the case in acute phthisis, and where the fatal termination is caused by an inflammation or hæmorrhage of the lungs supervening on the tuberculous lesion. In such cases, œdema of the feet, face, and other parts sometimes precedes death. But in the less rapid cases, and those which run their full course, the emaciation is excessive, and nothing increases it and the weakness so much as the colliquative diarrhœa, which generally occurs in the last stage of the disease. Shortly before death, the expectoration is sometimes suppressed, and sometimes it is changed in appearance, being a dark dirty green, or a reddish purilage with no mixture of mucus or froth.

The progress of the more prolonged cases is rarely uniform; it is marked by a series of attacks of increased symptoms, with a temporary amendment between them. This increase is generally referred to the weather, or increased exertion, and under favourable circumstances may be decidedly checked. Thus, patients often pass several years, losing ground in the winter and spring, and rallying somewhat during the summer, until, at length, they sink either under an attack severer than usual, or fairly consumed by the reiterated attacks of the disease. In some cases the improvement is more decided and lasting: the fever abates; the pulse loses its frequency; the cough subsides, and the expectoration becomes mucous and nearly ceases; and, in a few instances, the disease is entirely removed, and the flesh and strength restored. The local signs that countenance the hope that such an improvement may be lasting, are, a diminution of the pectoriloquy, cavernous breathing, and other signs of the excavations, the restoration of some vesicular respiration and sound on percussion to the part, whilst in the rest of the lungs the sounds are natural. There can be little hope of permanent improvement if there is strong hereditary predisposition, or marked symptoms of tuberculous cachexia, or any functional or constitutional disorder which materially impairs the general health.

Treatment. We have been led to conclude that the most important elements in the production of phthisical lesions are, a state of constitutional weakness or defective nutrition, and a local vascular irritation or congestion: these elements predominate in various proportions in different cases, and will require a corresponding variation in the treatment; but in almost every case, both the constitutional and local causes must be duly investigated and treated, or success will be only a matter of the most incalculable and irrational chance. In treating of the causes of consumption, we arranged cases in three groups: 1. Those arising from local disease; 2. Those originating from constitutional disorder, or hereditary predisposition, without any known previous local disease; and, 3. Those arising from local disease in subjects of hereditary or acquired scrofulous or phthisical constitution. In the two last, constitutional causes are recognised; and in the first, the local disease may act, not only by developing in the lungs lesions which tend to run a phthisical course, but also by injuring the functions generally, so that here too a constitutional cause becomes added. In no case, therefore, should we exclude constitutional treatment from a prominent place in the management of consumptive patients. It is where local disease has been the chief cause of the mischief, that we have the best chance of curing consumption, and the more so in proportion as the local lesions are limited, and the constitutional powers little impaired.

The chief indications in the treatment of tuberculous disease are, to diminish those local irritations and congestions that lead to the formation of the indurations or tubercles; to correct the condition in the system which degrades the nutritive process, and disposes to the deposition of imperfectly organised products; to promote the removal of those already deposited; and to

treat troublesome symptoms and accidental complications. These indications will predominate very differently in different cases, and in the different stages of similar cases; and although all should generally be kept in view, it will be more convenient to consider the treatment in relation to the stages of the disease than to these separate indications.

First stage. The symptoms of the early stage, that of the indurations, are those especially of vascular irritation and obstruction; hence this is the period at which antiphlogistic and counter-irritant remedies avail most. General bloodletting of from four to eight ounces, repeated every week or ten days, were highly recommended by Morton, Dovar, Fothergill, and Pringle, and more recently by Dr. Hosack of New York, and Dr. Cheyne of Dublin. The practice is still much pursued in this country; and if judgment be used with regard to the vascular strength of the subject, it is one of the most important agents which can be employed. We would, however, with Sir J. Clark, limit its use to cases in which there are marked signs of plethora, or of pulmonary inflammation, congestion, or hæmorrhage; and in other cases, and subsequently, prefer moderate local bleeding by leeches below the clavicles. The latter measure should be repeated whenever an increase of pain or cough, with a bloody tinge in the sputa, dulness on percussion, and irregular respiration or rhonchi under the clavicles, indicate a congested state of the lung about the suspected indurations.

In cases of greater debility, or where there appears to be a defect of blood in the system, blisters or other counter-irritants are more suitable than bloodletting. One of the best agents of this kind is a saturated solution of tartarised antimony, to be rubbed in below the clavicles twice a day, until a papular or semi-pustular eruption is produced. The friction should be renewed from time to time when this eruption dies away, as the symptoms may require it. We have sometimes added hydriodate of potash to the solution, with the effect of rendering it more irritating, and perhaps of acting favourably on the constitution by being partially absorbed. Issues and setons cause too much irritation of the system to be useful in this stage. A more moderate and general counter-irritation may be produced by sponging the whole chest once or twice a day with salt and strong vinegar, or with a liniment of oil of turpentine, acetic acid, and olive oil mixed by aid of the yolk of an egg, as recommended by Dr. Stokes, or with ammoniated liniment in various degrees of strength.

The efficacy of internal sedative or antiphlogistic remedies is more doubtful; except so far as they tend to diminish the irritation of the cough and the pain. Thus digitalis, hydrocyanic acid, and colchicum may, in some cases, subdue a temporary vascular excitement, and thus give relief; but the utility of continuing them long with the view to permanently reduce the pulse, may well be questioned; for they may thus do more damage to the constitution, than give relief to the irritation. In case of increasing bronchial or parenchymatous inflammation, or of fever, salines, antimonials, and other means of increasing the fluid secretions, will be proper as usual.

The narcotic remedies, such as opium, conium, hyoscyamus, belladonna, aconite, and hydrocyanic acid, are occasionally useful to allay cough and pain, especially when these symptoms are associated with high nervous sensibility or a tendency to spasm; but they have no influence on the incipient phthisical lesions, or on the inflammations or irritations accompanying them; and unless given judiciously, they may disorder the gastric and alvine function, and thus injure the state of the constitution.

But are there no remedies which will promote the removal of the indurations themselves? We can answer this but doubtingly; but if we may be guided by analogy, we might be led to hope that the removal of morbid deposits, when recent, may be facilitated by the aid of certain medicines. Thus we see tumours of various kinds, enlarged glands, and depositions in the joints, sometimes reduced under the use of mercury, of alkalies, or of iodine; and although there are many forms of deposit on which these remedies ex-

ercise no influence, and others in which their power is very equivocal, yet the limits of their action are not so defined as to prove that all the kinds of induration which precede tuberculous deposit are quite beyond their reach. The influence of these remedies in promoting the absorption of the simpler products of acute inflammation is scarcely doubted; and arising, as the lesions of phthisis occasionally do, from acute inflammation, and presenting various gradations which remove them only step by step from its products, it would be unreasonable to assert, without sufficient evidence to prove it, that they are wholly beyond the reach of such medicines. Dr. Stokes considers that the strumous inflammation which constitutes incipient phthisis, may sometimes be arrested by a course of mercury producing ptyalism; and he gives two or three cases to show the success of this mode of treatment. He admits, however, that its utility needs confirmation, and its exhibition must not be lightly attempted. It may, perhaps, be useful where the pulmonary lesion originates in acute inflammation, which has not proceeded to suppuration; otherwise its influence is generally so injurious in scrofulous constitutions, that we cannot advise its employment. This does not apply to its occasional use as an aperient, which is generally beneficial in this, as well as in other chronic diseases, in which the abdominal secretions need its aid.

Sir James Clark, on the ground of Dr. Carswell's view of the usual seat of tuberculous matter, has recommended anew the old practice of a course of emetics in the early stage of phthisis. The testimony of several English writers of the last century, Morton, Parr, Reid, Marryatt, &c., is strong in favour of the success of emetics in arresting and even curing the disease; but as we know that they did not possess the means of distinguishing phthisis in its early stages from other affections, we lose much confidence in their testimony. Nor are we disposed to trust implicitly the report of the only recent authority, Dr. Giovanni de Vittis, whom Sir J. Clark adduces: he states that in less than four years, 176 cases of phthisis were discharged from the hospital *perfectly cured*, 47 in the first stage, 102 in the second, and 27 in the third. But although these statements are too strong to be accepted without reserve, they are sufficient to warrant a further cautious trial of this method of treatment, in cases where there is sufficient strength to bear it. Various emetics have been recommended. Dr. De Vittis gave half a grain of tartar emetic in a tablespoonful of sweetened infusion of elder flowers, repeating the dose in fifteen minutes if necessary. This practice was pursued every morning and evening; the diet being farinaceous. Clark prefers an emetic of ipecacuanha or sulphate of zinc, or sulphate of copper, using only a little fluid during its operation, and for this purpose warm camomile tea is best. It may be given every day or less frequently, according to the urgency of the symptoms. Several writers assert that emetics may be continued every other day, and even oftener, for months without inconvenience. Sir J. Clark says, "There can be no doubt that the physicians who employed emetics thus extensively, were fully assured of the advantages which they produced; and their patients, we may conclude, must have been equally sensible of the benefit derived from them, otherwise it is scarcely credible that a practice so disagreeable would have been prescribed or persevered in." The same author supposes the action of emetics to be in great measure mechanical, dislodging the tuberculous matter, which, according to Dr. Carswell's notion, is first deposited on the free surface of the bronchial membrane. We would rather ascribe their beneficial operation to their powerful impression on the whole vascular and secernent systems, which tends to remove local congestions and obstructions, and to render all the secretions more fluid and free. It is not probable that this unpleasant practice will be sufficiently adopted or pursued as to be extensively useful; and there are many cases in which it cannot be even attempted.

We expect more from a much more manageable remedy, which we believe also to be capable of promoting the removal of phthisical lesions in their early stage, or of retarding their increase. This is iodine, in combination with dif-

ferent bases. We have been in the habit of giving it in incipient cases of consumption for the last twelve years. Dr. Baron of Gloucester, Dr. Morton of Philadelphia, and several others, have also spoken strongly in favour of this remedy. The form which we have found to agree best is the hydriodate of potash in small doses (two or three gr.) three times a day with twenty or thirty drops of liquor potassæ, in decoction of sarsaparilla, infusion of calumbo, or distilled water, according to the state of the system; adding a little tincture of henbane, digitalis, ipecacuanha, wine, or other medicine that the predominant symptoms may indicate. Where there is a tendency to feverish irritation, it may be given in a nitre draught; where there is vascular debility, it may be combined with mild tonic infusions. In chlorotic and in exsanguine scrofulous subjects, the iodide of iron is a suitable form; when it is borne, not causing headach and fever, or increase of cough, it rarely fails to improve the state of the general health; but it should always be combined with occasional local depletion, or external counter-irritation of the chest. When iodine agrees (and by varying its form and combination it may generally be made to agree), it increases all the secretions, and seems to give increased activity to the whole capillary system. In cases of gastric irritation, with pain in the stomach or heat in the throat, thirst and florid-tipped tongue, it should be suspended, and a dose or two of hydrarg. è cretâ given, followed by a few small doses of castor oil or a saline aperient; and after a few days the hydriodate of potash may be resumed, guarded by the frequent use of a farinaceous diluent.

But even in the cases in which phthisical lesions are most limited and merely nascent, we must never forget that it is not these lesions alone that we hope to remove. Their very presence in the system, or the operation of the constitutional or local cause that produces them, may lead to the formation of more; and in our treatment of the local causes, we should ever endeavour to remove those low degrees of vascular irritation, or that unhealthy condition of the nutrient matter of the blood, which, singly or combined, occasion the deposition of tuberculous indurations. But the constitutional treatment is also of the utmost moment; and in this we should seek for all those circumstances and agents that may best promote the due action and balance of all the functions. The purest air, and the most suitable climate for regular and ample exercise in it; the most nutritious food that the digestive organs can easily assimilate, and that the vascular system can bear without excitement; such remedial agents as give at once tone to the system, and promote the free action of all the secreting organs, together with friction, exercise, and proper clothing to maintain the activity of the superficial circulation;—these are the means which are rationally indicated to fulfil the object of improvement of the general health. But these means must be much varied to adapt them to the wants and capacities of individual cases, and it is in the study of these, and in the power of adapting the means to them, that the ability of the practitioner is seen.

Of remedial measures, those already named in relation to the local lesions and particular symptoms, may be combined or modified so as to act favourably on the functions at large. This is especially the case with iodine. Occasional mercurial and saline aperients will be generally needed to prevent internal congestions, and to promote the sufficient action of the abdominal viscera; but they should not be carried to excess, and their operation should be aided by due attention to diet. So also the functions of the kidneys and the skin may in particular cases be ameliorated by the aid of medicines; but the more that can be done by clothing, diet, and regimen, the better. Clothing, in particular, should be most carefully attended to; we have in it the means of affecting, sometimes powerfully, the whole vascular system; and if so regulated as to maintain a permanently warm and supple, but not relaxed state of the whole surface and of the extremities, it would prevent many of those fresh colds and exacerbations which are the great bane of phthisical invalids. In case of these aggravations, which commonly consist in an increase of bronchitis, but sometimes are pneumonic or pleuritic, the remedies for these affections must be

cautiously resorted to; always limited by the reflection that we are treating a subject that may already be weak from disease, in whom the restorative powers are lower than usual, and in whom the permanent source of irritation in the lungs will preclude that complete relief that antiphlogistic measures may give in simple inflammations.

In case of hæmoptysis, much care is required to remove the congestion or vascular fulness which occasioned it, before attempts be made to arrest it with styptics; otherwise the congestion may pass into inflammation, which occurring in a lung tuberculated and consolidated with hæmorrhage, is particularly destructive. Moderate repeated bleedings from the arm, or by cupping, and the use of tartar emetic in small doses, not sufficient to cause vomiting, together with digitalis and nitre, and morphia in case of nervous agitation, are the measures which we have found most availing. If, in spite of this, the hæmoptysis continue to any amount, the superacetate of lead, in the doses of two or three grains, with half a grain or less of the aqueous extract of opium, should be given every two hours, or as often as the urgency of the case may require. Fluid drinks in any quantity, especially warm, must be carefully avoided. Slight cases of hæmoptysis are sometimes effectually treated by a saline aperient, with diluted sulphuric acid; and freely opening the bowels always aids to prevent the return of hemorrhage.

Pure country air is almost indispensable to give any chance to the consumptive. If the disease be limited and chronic, and circumstances prevent him from giving up his employment in town, he should at least sleep in the country, and take every opportunity of longer absence. But the country must be dry, and not too much exposed to the east and north; otherwise it may only change the evil from cachexia to inflammation. There is no air which is so truly an antidote to the poisonous effects of a town residence, as that of a dry sea coast; and the more open this is for the summer, and the milder and more sheltered for the winter, the better for the consumptive. The benefit that patients often quickly experience from the change is most striking, even in the more advanced stages of consumption. To profit fully by the influence of pure air, the patient should be as much out of doors as the weather will permit; and use as much gentle exercise, both by walking and riding on horseback, as the state of the strength will allow, without inducing much fatigue. To those who bear them pretty well, sea voyages are sometimes highly beneficial; during the summer season, these may be confined to yachting about our coasts or crossing our seas; but the voyage to India, the Cape, to Madeira, or to the Mediterranean, may, with advantage, be made at a later season, with the view to pass the winter in these more genial climates. Of places for winter residence abroad, Madeira, Rome, and Nice are generally considered the choicest spots; we much prefer the former. Were there suitable accommodations for English invalids, we have reason to believe that parts of the north coast of Africa, particularly Tunis, would afford a climate better suited to the consumptive than any other of the Mediterranean. Of the milder spots in our own islands, the Undercliff in the Isle of Wight, Torquay, and Hastings, and the Cove of Cork, are those most favoured; but many places on the southern and western coasts, also present many advantages in point of mildness and equality of temperature, over all inland situations. When circumstances do not permit removal to these spots, and even in them in severe weather, the patient must be kept to rooms moderately and equally warmed (from 55° to 65°, according to the feelings), and as airy and well ventilated as they can be made without risk of draughts of air.

The diet in the early stage of consumption should generally be of a mild and unstimulating character, consisting chiefly of milky and farinaceous food. Sometimes white fish and chicken may be allowed; and a state of vascular debility, or previous habits, may make the plainer kinds of meat necessary; but this is especially the period of irritation or congestion, and more mischief is

likely to result from repletion than from moderation. For the same reason fermented liquors are not generally admissible at this period.

Second and third stages. When the signs and symptoms announce that the tubercles are softened and cavities in the lungs formed, it will generally be necessary to modify the treatment in some degree, for the constitutional debility then commonly increases, and the irritations may have diminished, or at least have not kept pace with the progress of the disorder. Here depletions are less needed, and worse borne; and a somewhat tonic plan of treatment, with some of the preparations of bark or iron if they can be borne, and more generous diet, with meat and malt liquor, may often be adopted with advantage; still counter-irritation will prove useful in most cases, and in these stages those kinds which cause a purulent or mucopurulent secretion will generally produce most benefit. In fact, the same abatement of irritation which we have before described to accompany free purulent expectoration, will in some degree follow from this external suppuration, without the wasting and harassing effect of such a discharge from the lungs. With this external outlet as a sort of safety valve, strengthening medicines and nourishment may be borne; and there is less risk in restraining any excessive secretion which may take place from the lungs, the bowels, or the skin. Much attention is necessary to keep up the artificial discharge, whether it be by the formation of successive crops of pustules, by tartar-emetic solution or ointment, or some similar suppurating liniment, or by a seton or issue. If it be suddenly checked, there will in all probability be an increase of pulmonary irritation, perhaps attended by the deposition of more tuberculous matter. In slighter cases, or where the weakness or irritability forbids these measures, occasional blisters, or the frequent use of milder liniments, containing tartar emetic and hydriodate of potash, or diluted nitromuriatic acid and oil of turpentine, are often productive of some benefit.

In the softened tuberculous and ulcerated stages of phthisis the constitutional powers especially need support; and it is then, more particularly even than in the first stage, that the general measures are required; but unless the disease be limited in extent, there is, for the same reason, less hope of their success. The disease has existed longer, and passed into a stage in which it is more likely to have tainted the system. The preparations of iodine and other tonic alteratives should be used more freely; and the general health supported by all the medical and hygeian circumstances that can be brought to bear on it. There are vomicæ to be evacuated, and the object is to assist nature in effecting this object; in protecting the lungs from further injury during this process, and in effecting the healing of the fistulous cavities which are left. The means already recommended to strengthen the general health, are those which most conduce to these ends; but it is necessary to advert to some topical measures which have been supposed to promote greatly these objects. These are the direct application of certain gases or vapours to the lungs themselves, by means of inhalation. The only agents to which we need advert, as having been by good authority reported to be useful, are chlorine, the vapour of iodine, and that of tar. The last was recommended by Sir A. Crichton. The vapour is diffused through the patient's chamber, by heating the tar to gentle ebullition, with a little carbonate of potash to retain the irritating pyroligneous acid. From the more extensive trials of Dr. Forbes, it appears that this remedy was often injurious and seldom of marked benefit in phthisis, but in bronchial disease it proved salutary. Dr. Morton of Philadelphia, and Drs. Hufeland and Neumann of Berlin, are stated by Sir J. Clark to have reported more favourably. The inhalation of chlorine was first recommended by M. Gannal, and several French physicians have spoken favourably of it. Sir C. Scudamore reports that he has effected several cures by the inhalation of chlorine with the vapour of tincture of conium or some other narcotic. Sir J. Clark states, that in several instances in which he tried it, it relieved dyspnœa and apparently suspended the progress of the disease. Our own experience of

the inhalation of chlorine is not favourable; having generally found it increase the cough and other symptoms of irritation; Dr. Stokes reports to the same effect. But we should expect some benefit from it, where there is little disposition to inflammatory action, particularly when the expectoration is profuse and fœtid. The vapour of iodine has also been much extolled as a means of promoting the removal of tubercles and the cicatrisation of cavities; but there is not yet sufficient evidence in its favour to warrant us in recommending it. The usual modes of inhaling these vapours (through tubes adapted to a bottle containing hot water with a certain addition of the chlorine or iodine to it) have always appeared to us objectionable, inasmuch as the tubes are generally too small, and the effort of inhalation is irksome to most patients. It would be much easier to use a large open vessel of hot water, such as a basin or jar, and add to it, by degrees, the required quantity of liquid chlorine, or tincture of iodine; or place it in a saucer floating on the hot water; the patient might then approach his nostrils as near as he can bear without causing him to cough. This might be repeated twice a day or oftener. Dr. Corrigan has devised an apparatus by which the liquid chlorine or iodine can be made to drop slowly into a vessel of water kept boiling by a lamp. He found that when iodine is diffused in this mode through the apartment of the patient for some time, it could be detected in the urine.

It is not unlikely that by very judicious management, the inhalation of various agents may sometimes conduce to a healthier and healing action in the interior of ulcerated lungs. But we must chiefly look to the improved state of the constitution for this healthy action, and for what is of more immediate moment — a cessation of that disposition to deposit more tuberculous matter in other parts, which too commonly prevails during the softening and the evacuation of tubercles.

In very many cases, alas! no means will stay the progress of consumptive disease, and the utmost that we can do is to give temporary relief to the more distressing symptoms; to the cough, sometimes by a leech or two over the windpipe, but more commonly by various narcotic remedies, such as conium, hyoscyamus, hydrocyanic acid, and particularly opiates, of which the compound camphor tincture, and Squire's solution of bimeconate of morphia in small doses, we have found the best; to pains in the side, by a mustard poultice, a turpentine fomentation, and if these fail, by a few leeches or a blister; to the dyspnœa, by æther and ammonia, or paregoric, or tincture of lobelia, or, according to Sir J. Clark, by extract of stramonium, half a grain in the day; to the hectic heats, by sponging with tepid vinegar; to the sweats and to excessive expectoration, by acid and tonic mixtures; to the diarrhœa, by astringents, preceded by a mercurial aperient, and accompanied by a suitable diet. In not a very small number of cases we may considerably prolong life by watchfulness and judicious measures. Consumption may run its course in a few weeks; but it may exist in a limited and chronic form for many years, and such cases may reward us for our attention and judicious treatment, if not by permanent recovery, at least by temporary restoration of a moderate share of health and strength, compatible with the enjoyment of life, and with the fulfilment of important duties in society.

Prevention of tuberculous disease. The small chance of doing good which the healing art possesses in tuberculous disease is a great reason why our attention should be directed to measures of prevention from which much benefit may reasonably be expected; and it is on this department of practice that our improved knowledge of the pathology may be brought to bear. The prevention or speedy removal of those inflammations and congestions which contribute to develop phthisical lesions, and of that state of strumous cachexia, or imperfect nutrition, from which they especially arise, constitute the indications for prevention which pathology suggests. To fulfil these indications is to remove or counteract the several causes which we have specified as producing or increasing consumptive disease, and the means of effecting this,

comprehend many remedial and hygeianic details. It is only necessary here to advert to some of the more prominent.

The earliest and at the same time the least doubtful cause of phthisis is hereditary predisposition; and when this has been fully acquired, either this or some other form of scrofulous disease generally ensues sooner or later. But it is very probable, as Sir J. Clark has suggested, that the formation of this predisposition could be in great degree prevented by attention to the health and alliances of successive generations. "If," says he, "a more healthy and natural mode of living were adopted by persons in that rank of life which gives them the power of choice, and if more consideration were bestowed on matrimonial alliances, the disease which is so often entailed on their offspring might not only be prevented, but even the predisposition to it extinguished in their families, in the course of a few generations."

The propriety of avoiding intermarriage with those families which have shown proofs of consumption is obvious, as nothing is more likely to increase the tendency. The health of mothers during uterogestation and suckling should also be carefully guarded; and the children of consumptive families must be reared from birth to maturity with the fullest possible regard to their physical condition, and every precaution against causes of disease and derangement of the general health. Warm clothing, well-ventilated rooms, a healthy residence, plain nutritious food, but of due quantity and quality, regular and frequent but varied exercise in the open air, as far as the season will permit—that on horseback is the best; daily use of the cold bath, or free sponging, followed by friction; strict attention to the state of the excretions, and their regulation, if necessary, by diet and mild remedies, constitute the chief general means to be employed to fortify the constitutions of those in whom there is reason to suspect a disposition to phthisis. Frequent change of air, particularly from inland to coast and the converse, is generally beneficial, as far as that can be practised without incurring exposure to an unhealthy or too cold an atmosphere. Occasional sea voyages are sometimes of marked benefit in generally strengthening the constitution. A residence for some years in a warm climate is indicated for those whose brothers or sisters have become consumptive in this country about a particular age; but on their return, even although the critical period be passed, unusual care will be necessary for some time. So, on the other hand, those who become enervated and languid during the heat of summer, should resort to a mountainous district or an airy coast during that period. The great object is to prevent the general strength from being lowered, or the functions deranged, by any influence whatsoever, and this is generally better effected by hygeian than by medicinal means; but we may and often must bring to our aid tonics and alteratives of various kinds, as well as the different remedies that are required to improve the secretions. It is impossible to enter into any details, for very different remedies may be best suited to different individuals; but if there be any which are so more commonly than others, these are combinations of iodine and of iron, and courses of saline or saline chalybeate mineral waters. With the view to strengthen the lungs, and to render the pulmonary system less apt to suffer from cold or heat, the regular practice of freely sponging the chest and whole trunk with vinegar and water, or salt and water, followed by vigorous friction, deserves especially to be recommended. It not only improves the tone of the respiratory apparatus, but diminishes the liability to bronchial affections from exposure to cold: these affections are the most common causes of the development of tubercles.

MALIGNANT GROWTHS IN THE LUNGS.

Encephaloid disease of the lung. — Scirrhus. — Melanosis and spurious Melanosis.

We need say little on the subject of encephaloid, scirrhous, and melanose disease of the lungs; for their occurrence is too rare to be of much practical importance, and they are not known to be influenced by medicine. They may occur in a circumscribed form, or pervading a considerable extent of the pulmonary tissue; and they would then produce physical signs like those of consolidation from hepatisation or tuberculation of similar extent, and could be distinguished from these only by the history and general symptoms, and by the absence of the constitutional indications of tubercles. They commonly cause death, either by their encroachment on the function of the lungs, or from being simultaneously deposited in other organs, such as the mesentery, the liver, the ovaries, &c. But when they occupy the lung chiefly, both encephaloid and melanose deposits tend in time to soften and form ulcerous cavities as in the case of tubercle. We have seen such cavities more than once in both these forms of disease.

The general appearance of *encephaloid disease* or *medullary sarcoma*, is that of a brain-white solid, of varying consistence, with a pinker hue than that of tubercle, occurring either in separate tumours, which are sometimes encysted, or infiltrated through the tissues of the lung, and modified by their colours. When occurring in separate tumours, it is sometimes soft and cellular; in other cases tougher, and more like the pancreas; in others, again, it becomes of fibro-cartilaginous hardness. A predominance of a loose cellular and vascular structure in it, with patches of extravasated blood, give it occasionally the appearance that has obtained for it the name of fungus hæmatodes. We may conjecture that the albuminous matrix of these products is deposited in an organisable form, and vascular ramifications are certainly formed through it; but it is deficient in the cohesion and contractile tendency of ordinary false membranes; it does not restrain the further effusion from the vessels, whence the tendency to growth in these productions. When encephaloid matter occurs in an infiltrated form in the tissue of the lung, it sometimes presents an appearance intermediate between that of tuberculous and that of hepatised consolidations; and unless there be portions of the diseased production occurring separately, it might be taken for one or other of these lesions.

The only form of disease which we have seen affecting the lung, which approaches in any degree to *scirrhus*, is that which we have already described as a result of a chronic pleuro-pneumonia; there being in these cases firm adhesions to the pleura, a shrunk state of the lung, and dilatation of the bronchial tubes. The induration and glistening texture which the lung so changed sometimes exhibits, especially around the larger air-tubes, might lead one to suspect it to be of a scirrhous nature; but we have seen neither the tendency to cancerous ulceration, nor the simultaneous occurrence of scirrhus in other parts, which might be expected if this induration of the lung were really of a malignant kind. Dr. Corrigan seems to have lately described a similar morbid condition, which he calls, not very appropriately, cirrhosis of the lung.

We have met with several cases of *melanosis*, or *black tubercle*, affecting the lung, both exclusively, and with the same production in other parts of the system. We have seen it combined with encephaloid disease. The black matter may occur infiltrated in a natural structure, or in distinct tumours or deposits of an irregular cellular organisation. We are much inclined to adopt the opinion of Andral, that the black matter is nothing but a modification of the colouring matter of the blood, in which carbon is in excess, or even in a free state. We have seen the deposits exhibit in different parts various shades of colour, from the dark cruor red of hæmorrhagic engorgement to the deep

jet black of perfect melanosis. The intermediate colours were of a bistre or sepia brown. The organised texture of melanose tubercles and tumours presents considerable variety, sometimes approaching to the most perfect products of acute inflammation, being soft and cellular or membranous; and sometimes having almost the totally unorganised structure of scrofulous tubercle. Probably it is only this latter form that undergoes the changes of softening and ulceration ascribed to melanosis by Laennec; and under these circumstances, such changes are to be referred to the same causes as those which operate in the kindred changes of tubercle. The presence and modification of the colouring matter of the blood seems, therefore, to be the essential pathological condition of this disease, as an altered or deficient vitality of the fibrinous matter is of tuberculous affections.

It is necessary to avoid confounding with melanosis the accumulations of the black pulmonary matter, which take place to a great extent in the lungs of old people, especially among the inhabitants of large towns. These are probably, as Dr. Pearson supposed, derived from the soot inhaled with the air; which, we presume, finds access to the texture of the lungs chiefly through abrasions, softening, or other such lesions of the bronchial membrane, which, in a slight degree, often result from a common cold or cough. Whether from this source, or, as others have supposed, from an altered state of the colouring matter of the blood itself, we think it is plain enough, that when once deposited in any corners out of the immediate sweep of the circulation, such as in the angles of lobules, near old lesions, around large vessels, and in the bronchial glands, there it must lie, accumulating until death, or until it is carried off by the destruction of the tissue by some pulmonary disease. For it consists entirely of carbon; and this being totally insoluble in any animal fluid, is insusceptible of absorption, which scarcely acts on insoluble solid matter. For the same reason the carbonaceous matter of tattooed skins, and the insoluble oxide or chloride of silver in persons coloured blue from the too long internal use of nitrate of silver, are permanent, and can only be removed with the skin itself. It does not appear that this carbonaceous deposit in general interferes materially with the function of the lungs; but there are some curious cases on record. in which it has taken place so rapidly and extensively as to cause chronic inflammation and consolidation of a perfectly black colour, which tends to ulceration and the formation of cavities, as in other cases of chronic consolidations. Such cases are described by Drs. Gregory, W. Thomson, and others, as occurring particularly in coal-mines, and in persons labouring under bronchial disease whilst continually employed by the light of smoky lamps.

The general symptoms of encephaloid or melanotic consolidation of the lungs, are those of obstructed breathing or circulation, dyspnœa, lividity, and dropsy; more commonly than those of consumption and emaciation, which belong rather to tuberculous disease. This is explained by their more rapid development, and their not so readily leading to softening and ulcerative destruction of the organ. When this process does occur, the expectorated matter may afford means of distinction. We have seen, in the case of encephaloid disease, streaky red and white purilaginous liquid sputa, and, in melanosis, a considerable quantity of black matter, mixed with a muco-purulent compound. But such cases are not common, and the expectoration is more usually that of the bronchitis or pneumonia that may accompany the disease.

DISEASES OF THE BRONCHIAL GLANDS.

The *bronchial glands* are not udfrequently found after death in a diseased state, even when no symptoms referrible to them had been manifested during life. We do not mean the deposit of black matter like that of the lungs, for that is so constant that it can scarcely be considered to be morbid. But they are sometimes found swollen and red, or containing caseous matter, or osseous

concretions. In children they are occasionally so enlarged by the deposition of tuberculous matter, as to press on the air and bloodvessels, and, according to Dr. Carswell, to produce dyspnœa and symptoms of obstructed circulation. They sometimes soften, and become evacuated by ulceration into the bronchi. Encephaloid disease, as well as extensive enlargement, not of a malignant character, may also affect these glands. We suspect that encephaloid disease of the lungs generally originates in this way, and spreads afterwards along the vessels into the pulmonary tissues. We have also met with cases of dulness on percussion on the top of the sternum, with signs of obstructed circulation and respiration, with simultaneous enlargement of the axillary and cervical glands, betokening a glandular tumour about the root of the lungs; and all these symptoms gradually subsided under the use of iodine and alkalies; so we conclude that the tumour was simple glandular enlargement. Considerable tumours of the bronchial glands might perhaps sometimes be discovered by dulness on percussion on the upper portion of the space between the clavicles, and on the spinous processes of the upper dorsal vertebræ. The tumours generally, however, grow forwards, and we have seen them pushing out the sternum or the ribs on one side, and causing dulness at those parts, and symptoms of displacement of the lung further down. They also may produce signs by their pressure on the great vessels, arterial and venous, simulating those of aortic aneurism; and we have known them compress the great bronchi to a fatal extent.

INFLUENZA.

Nomenclature. — Description. — History of the principal visitations. —Diagnosis. — Nature of the disease. — Source of the epidemic. — Treatment.

The malady to which, from the supposed influence of the stars in its production, the name of *influenza* has been applied, is an epidemic affection, usually accompanied with catarrhal symptoms, and with a depression of strength far greater than is proportionate either to the febrile excitement, or to any accompanying local disorder. It is the *Rheuma epidemicum* of Sauvages, the *Catarrhus epidemicus* of Swediaur, *Catarrhus à contagio* of Cullen, *Amphimerina anginosa* of Huxham, *Febris remittens catarrhalis* of Macbride. By the French writers it is called *Folette*, *Coqueluche*, *Petite poste*, *Coquette*, *Baraguette*, *Rhume épidémique*, *Fièvre catarrhale;* by the Italians, *Catarro Russo;* by the Spanish, *Influencia Rusa;* by the Germans, *Huhnerzipf*, *der Hühner Wenn Bletzkurr*, *Epidemischer Schnupfen*, *Russische Krankheit.*

Of all epidemics it is the most rapid in progress, sudden in invasion, and extensive in range. The complaint usually commences like a feverish attack, with a feeling of chilliness and a sensation as of cold water running down the back; weariness and stiffness of the limbs, and pains in the neck, back, and loins, more intense than those which attend the common forms of fever. In the more severe cases there is decided rigor alternating with heat and flushing of skin; the fever has an exacerbation every evening, and lasts from two to fourteen days: pain is felt over the frontal sinuses and cheek-bones, or behind the sternum. The eyes are suffused; there is sneezing, tingling, and an acrid discharge from the nostrils; a short, frequent, harassing cough; a feeling of constriction of the chest and throat, and not unfrequently soreness, redness, and tenderness of the fauces. The inflammation of the tonsils is occasionally intermittent. The expectoration, at first scanty and difficult, consisting of thick viscid mucus, usually devoid of air-bubbles, subsequently becomes opaque, copious, and muco-purulent. Sonorous, mucous, and sibilous rhonchi may be detected by auscultation, and there is frequently partial crepitation, which is most apt to occur at the lower portion of the lungs. The circulating system is depressed,

the pulse being usually feeble, soft, and quick in the early stages; in the decline of the disease slow and sometimes intermitting. The appetite is impaired and the taste perverted; nausea and vomiting are often present; the tongue white and moist, covered with a creamy mucus, or loaded with a coating of moist yellowish fur, and presenting elevated papillæ of a peculiar vivid red colour at the edges: in some severe cases it is, however, little affected. In most instances the urine is scanty and high-coloured, soon becoming thick and reddish, or assuming a whey-like appearance, and depositing a copious pink or whitish sediment. The depression of strength is extreme, occasionally resembling the collapse of cholera; the moral energy is subdued, and agonising fears of death are sometimes present. The skin, at first hot and dry, soon becomes perspiring, and often exhales a peculiar, flat, musty smell; sometimes it assumes a bluish hue. When the lungs are not materially affected, the force of the morbid influence is in some instances directed to the bowels, producing pain and tenderness of abdomen, and diarrhœa, with mucous or dysenteric evacuations; at other times, the brain being chiefly involved, vertigo, sleeplessness, and delirium, are prominent symptoms. In very old and debilitated subjects, the disorder often presents the character of suffocative catarrh. Among the most characteristic phenomena may be mentioned the persistence of cough and debility, long after the cessation of the other symptoms.

The most frequent and important complications are, inflammation of the bronchial tubes, lungs, pleura, or of the brain and its membranes, acute articular rheumatism, neuralgia, and cutaneous eruptions. The nature of the complication occasionally depends on constitutional peculiarities, but frequently on exposure to the exciting causes of the associated diseased action, about the time of the onset of the attack of influenza. Thus, for example, exposure to damp under such circumstances will occasion a liability to rheumatic complications, and fatigue or mental anxiety to erysipelas. The principal varieties of the complaint depend partly on atmospheric conditions, partly on the predispositions of the persons affected: they may be divided into, 1. The cerebral, characterised by vertigo, delirium, erysipelatous eruption on the face, sometimes swelling of the parotid glands. 2. Guttural, attended with Cynanche tonsillaris. 3. Bronchial, with difficult oppressed respiration: this variety, when occurring in its severe form, constitutes suffocative catarrh. 4. Intestinal, with diarrhœa, mucous evacuations, and in some examples tenderness of abdomen. 5. Typhoid: this form, which rarely occurs except among the poor and badly nourished, is characterised by depression of pulse, extreme prostration of strength, and other symptoms of putrid or adynamic fever. One of the most important considerations connected with the subject of influenza is the tendency of the disease to alter the condition and increase the susceptibility to disordered action of the nervous system and of the mucous membranes. A succession of attacks more commonly occurs in this than in any other febrile disorder; and the part to which the force of the disease has been most directed, remains peculiarly susceptible of derangement: thus a liability to chronic bronchitis, to intestinal irritation, and to rheumatic and neuralgic affections, often remains for years after a severe attack of the malady; and the subjects of such complications appear less tolerant of active remedies. Almost every visitation of influenza, although characterised by the predominance of some one variety, generally presents examples of each, besides, in some instances, exhibiting phenomena peculiar to itself. The various features of the disorder will therefore be best exhibited by a review of the most remarkable examples related by authors.

History. Hippocrates and other ancient authors give slight notices of catarrh resembling the disease under consideration. In later times the epidemics of 1311, 1323, 1327, 1387, 1400, 1403, 1410, 1414, 1427, 1438, 1482, and 1505, were probably examples of the same affection.

That of 1323 prevailed throughout the whole of Italy, and, according to Buoni Segni, was attributed to a pestilential wind. In 1387 the disorder prevailed at Montpellier and Romagne, and is said by Valesco to have attacked nine tenths of

the population. In 1403, according to Pasquier, a catarrhal visitation occurred at Paris, so severe as to render it necessary to suspend the assizes. The epidemic of 1410, described by Valesco, was characterised by harassing cough, which was regarded as a punishment for singing a licentious song. The visitations of 1414 and 1448 were peculiarly destructive to the aged. Although the short notices now extant of the above epidemics render it extremely probable that they were examples of the disease in question, yet the first instance which we are fully authorised to refer to it, and the first accurately described by medical authors, is that which occurred in the year 1510, and proved fatal to Ann, wife of Philip of Spain. According to Schenck, it was regarded as a new disease. The epidemic proceeding in a north-westerly direction from Malta to Sicily, Spain, Italy, France, and Britain, raged over all Europe, and scarcely missed an individual, but few died except children. The complaint was attended with violent pain over the eye, and with the usual symptoms of more recent attacks. Delirium and gastrodynia were often present, and in some instances, from the seventh to the eleventh day of the attack, snatching of the tendons and syncope occurred. Diarrhœa, or sweating, were common at the decline. It was a frequent practice to apply five blisters, two to the legs, two to the arms, and one to the back of the head. Bleeding and purging are said to have been injurious. A similar disorder prevailed in the autumn of 1557, after a hot dry summer followed by cold northerly winds. The malady was in some places preceded by ill-smelling fogs, and followed by great inundations. The disease took a westerly course from Asia by Constantinople to Europe, and afterwards visited America. The attendant fever, according to Mercatus, exhibited the character of a double tertian. This epidemic was more destructive than that of 1510 : 200 persons fell victims to it at Alkmaer in Holland, and 2000 in the small town of Mantua Carpentaria. In the latter instance the mortality was attributed to the employment of bleeding; but many persons of opulence perished under the suspicion of being poisoned. A similar mortality attended the epidemic catarrh of 1580 : 9000 died of the disease at Rome, according to Wierus, in consequence of bleeding. The course of the affection was from east and south to west and north. It raged in France after a cold dry wind, following long-continued warm moist weather. A prodigious number of insects covered the roads in France about the time of its appearance. In many places it was observed that animals accustomed to feed on herbs and leaves, took a dislike to their pastures. Birds of passage migrated before the usual time, and those that sleep in low valleys repaired at night to higher districts. (*Salius Diversus de Febre pestilentiali.*) The disorder raged at Sicily in June, at Rome in July ; proceeded by Venice and Constantinople to Hungary and Germany, thence to Norway, Denmark, Sweden, and Russia, where it prevailed in December. Although the plague proved very destructive during this year at Cairo, it is remarkable that no European country was visited by that disorder except France, which had been the first to suffer from the catarrhal epidemic.

Bleeding from the nose frequently occurred during this epidemic, but the most characteristic symptoms were vigilance or somnolency, giddiness, resembling that of intoxication, and swelling of the parotid glands. Riverius and Forestus, contrary to the observation of Wierus, speak of bleeding as an important part of the treatment. Sixty thousand persons are reported to have died at Rome in the years 1590 and 1591 of a similar epidemic, associated with severe cerebral symptoms. Another visitation occurred suddenly in April, 1658, and was chiefly prevalent in England, after great extremes of weather : the following summer was exceedingly hot, and a fatal epidemic fever prevailed at its close. In 1663 it is said that 60,000 persons were attacked with influenza in the Venetian states in one week. The disease was attributed by Paulini to an intense fog, which came from the Adriatic. In 1669 a similar affection prevailed in Holland, and proved fatal to Sylvius de la Böe. In 1675 Germany was visited in September, and England in October, by a similar

epidemic: the previous summer had been unusually warm, and followed by cold moist weather. It is worthy of notice, that the plague prevailed that year in Malta, although it did not visit that place afterwards till 1813. This epidemic was preceded in France by thick fogs. The disease is said by Peu to have been peculiarly fatal to women in the puerperal state. The influenza which prevailed throughout all Europe in 1729 and 1730 was attributed by Hoffmann to changes of weather from heat to cold, and cold to heat, greater than he had ever experienced; by Lœu it was referred to thick sulphurous fogs. Several earthquakes occurred about the same time, and he considered these, as well as the sulphurous transpiration, to be occasioned by the non-occurrence of an eruption of Vesuvius. This catarrhal fever visited every part of Europe in the course of five months, and attacked 50,000 persons at Milan, 60,000 at Rome, and the same number at Vienna. It was very fatal in Paris and London; in the latter place destroying a thousand a week, in September, a greater number of deaths than had occurred in this city in so short a time since the period of the plague. Switzerland suffered little, Italy and Spain very considerably. The disorder generally proved most severe in low marshy situations. In some places it was complicated with petechiæ. Hysterical subjects, when suffering from the epidemic, complained of a peculiar feeling of cold in the course of the sagittal suture. Sanguineous discharges frequently occurred at the termination of the disease, and bleeding was in many instances employed with advantage.

The influences on which catarrhal epidemics depend appear to have continued in operation from the year 1732 to 1737, and they were associated with remarkable electrical and telluric phenomena. During the spring and autumn of 1732 the weather was unusually dry; the aurora borealis was often peculiarly vivid; volcanic eruptions occurred in various parts of the world; south winds were attended with a dry, and those from the north with a rainy, state of the atmosphere. The disorder is said by Huxham to have ceased suddenly after the explosion of a meteor in the air, which was accompanied with a fetid fog, and produced, for an hour, an appearance as though the north of the heavens was on fire.

It was observed that the epidemic was most apt to be complicated with pectoral affections about the time of the equinoxes, and that cough was generally relieved by diarrhœa, whether occurring spontaneously or produced by purgative medicine. In the autumn of 1732 the disorder overran Europe, and visited America. In Britain its course was southerly; it appeared at Edinburgh in November, and did not reach Cornwall till February in the following year. From New England in America it spread southward to Jamaica, Peru, and Mexico. This epidemic affected the intestinal as well as the respiratory system; sanguineous discharges from the nose, lungs, and bowels were frequent, especially when bleeding was omitted. Swelling of the parotid and salivary glands, and of the testes, was occasionally observed. In Edinburgh the poor and those most exposed to atmospheric vicissitudes suffered most. The inmates of the prison and of Heriot's hospital entirely escaped the malady, and although the interments at the Grayfriars' Burial-ground were twice the usual number in the month of January, 1733, yet the fees from the opulent classes did not exceed the common average. Before the eruption of the disease, cough prevailed extensively among horses. The years 1741 and 1742 were remarkable for atmospheric vicissitudes, frequent appearances of the aurora borealis and of meteors resembling soldiers fighting in the air. Catarrhal fever visited several countries during the years 1741 and 1742; and in the spring of 1743, after five months of excessively severe weather with easterly winds, prevailed generally in Europe under the name of *La grippe*, a word probably derived from *chrypka*, the Polish word for hoarseness. Destructive disease existed at the same time among horses and deer. The influenza commenced with lassitude and shivering, cold hands and feet, pains of head, limbs, and spine, inflamed eyes, loss of taste and appetite. There was a remission of fever at four or five in the evening, and an exacerbation at night. The decline of the disorder was sometimes accom-

panied with diarrhœa, at other times with an eruption of pustules on the skin. Sauvages describes a hissing noise occurring in the cough of old people affected with the complaint, many of whom died on the ninth or eleventh day. This epidemic preceded the plague in some parts of Sicily. It was less fatal throughout England than in other countries; nevertheless, a thousand died of it during one week in London. Epistaxis was a frequent symptom, and in young plethoric subjects bleeding was found useful, and, according to Sauvages, might be repeated with advantage; but Sennertus attributes the destructiveness of the disease at Rome to the injudicious employment of that measure.

The spring of 1762 was characterised by remarkable alternations of intense heat and cold, and by a rapid succession of wind, frost, snow, and rain; and epidemic catarrh was general in Europe. It had however appeared during the previous year in America. The disorder swept away one third of the inhabitants of Toulon, extended northwards to Breslau, Vienna, and Hamburg, and in a month passed from London to Edinburgh. This epidemic was singularly capricious in its course and severity, destroying a hundred daily at Breslau, yet sparing Paris and the greater part of France: it was exceedingly mild in many parts of England, especially London, the suburbs of which escaped, but in Norwich was more fatal than the visitation of 1743. It prevailed among the sailors in the Mediterranean in July, during the prevalence of hot weather with easterly winds. Those who were severely attacked usually had either head symptoms, or harassing cough. These symptoms sometimes alternated with each other, but scarcely ever existed together. At the end of the second week at Edinburgh some of those affected complained of pains of the thigh, others had maniacal attacks. A large proportion of the inhabitants of Europe suffered from the complaint; but scarcely any died, except the old, the asthmatic, and the consumptive. Relapses were frequent, and those who neglected themselves had a tedious cough with some degree of fever, which occasionally was intermittent, and yielded to bark.

The autumn of 1775 appears to have been remarkable, both in France and Britain, for thick noisome fogs, so prolonged as to obscure the sun for many weeks. In France the weather was cold and rainy, in Scotland unusually dry. The commencement of the year was very cold, then followed snow, abundant rain, and sudden changes of temperature. These vicissitudes occurred later in England than on the Continent, in correspondence with the later appearance of the epidemic. Disease prevailed at the same time among dogs and horses: meat suspended in the air by means of a kite, near Glasgow, quickly became tainted. Dr. Fothergill, with laudable zeal, engaged in a correspondence with various practitioners on the subject of the epidemic, and much valuable information was thus obtained respecting the local peculiarities of the complaint. This visitation was mild in its character, especially in England; and most of the deaths which occurred were attributed by Dr. Macbride to the omission of bleeding. More men than women suffered, and, with the exception of Dr. Ash of Birmingham, most observers agree, that those who were most exposed to the weather were most liable to the attack. Sir George Baker remarks, that girls' schools frequently escaped, whilst boys' schools were often severely affected. The complaint was attended with pain in the loins and sides, and occasionally with cramps; there was frequently itching of the skin; in some instances an eruption of pustules, in others erysipelatous redness; and Dr. Heberden saw two cases in which there was a rash resembling scarlatina. Suppuration of the parotid glands occasionally occurred, and a tendency to somnolency was sometimes present. Dr. Thompson of Worcester in some instances observed an alternation of delirium, stupor, and cough. Dr. Haygarth in one case remarked the following symptoms in succession,—diarrhœa, delirium, cough, and an exanthematous eruption; subsequently the cough returned, and continued as the prominent symptom till the disease subsided. The average duration of the complaint was five or six days. Dr. Fothergill mentions that those patients soon recovered, who, within thirty-six hours after

the onset of the disease, had a free discharge from the nose, copious expectoration, perspiration, or bilious evacuations. Sir George Baker notices a milky appearance of the urine as an indication of recovery. The decline of the disease was attended with a febrile condition, which was often intermittent. This state on the Continent was relieved by bark, but in England that medicine only aggravated the fever, and purgatives were found requisite. Several peculiarities of a local character deserve to be noticed. In many places bleeding was found useful, but Dr. Ash of Birmingham mentions that none died in the workhouse of that town except those that were bled. In some districts the disorder was partial, in others general. Thus for example, at Exeter, of 173 persons in the hospital only two children escaped; and at Chester all the inmates of the house of industry, amounting in number to 175, suffered from the malady. At York, the inhabitants of which are peculiarly prone to constipation, the disease was usually combined with diarrhœa. At Aberdeen the attendant fever never assumed the intermittent character. Dr. Fothergill observes that the blood taken from patients under the complaint was uniformly sizy; the size being rarely cup-like, but resembling a flat cake of yellowish tallow, floating on deep yellow serum: this observation, however, is not confirmed by other observers. The epidemic is said to have ceased suddenly on the setting in of a frost.

The influenza which raged in England in the spring of 1782 appears to have travelled from the east. It was termed *Bletzkarr*, from the suddenness of its invasion. In September, 1780, the crew of the Atlas, East Indiaman, suffered from the malady on their course from Malacca to Canton. Although no instances of the disease had occurred at the former place, they found, on arriving at Canton, that it had raged there associated with bilious complaints, which attended it also in October, 1781, on the Coromandel coast and in Bengal. In November, 1781, the epidemic attacked the army besieging Negapatam; it prevailed at Astrachan, Tobolski, and Moscow, in December; Petersburg in January, 1782; and Strasbourg in February; spreading through Denmark and Holland (where it received the designation of *Morbus Russicus*) in March, it arrived in England at the end of April, making its first appearance at Newcastle-on-Tyne. This epidemic attacked three fourths of the population. It was observed to visit towns before villages, and villages sooner than detached houses. It took three weeks to pass from Edinburgh to Musselburgh, which lies five miles to the south-east. The most prominent symptoms were, loss of smell and taste, feeling of contusion in the limbs, darting pain and sense of constriction in the forehead and temples, and sometimes of the whole face, with soreness under the muscles of the cheekbones. This last symptom sometimes occurred without catarrh, at other times preceded it. Languor, dejection, and depression of spirits, were always present in a high degree, and even in the milder cases the countenance was much altered. There was considerable constriction of chest, dyspnœa, and generally cough, which produced much pain behind the sternum, and aggravated the suffering in the frontal sinuses. In some instances pain in the chest and sides constituted the only symptom. When the catarrh was slight, the disorder had more the appearance of an attack of fever, at first intermittent, and afterwards marked by a quotidian exacerbation like continued fever, and attended with cough, and pain of chest and head: in these cases bark was found useful. Dr. Haygarth considered the disorder contagious. In the plethoric, delirium frequently occurred, particularly at night. Bleeding was not generally found expedient. As in other visitations of influenza, six weeks was the average continuance in each place, and those most exposed to the weather suffered most from its influence.

As respects the relation of this epidemic to meteorological conditions, we may mention that the summer of 1781 was excessively hot and dry, no rain falling in England from the middle of June to the middle of September; the autumn was cold and damp, and the winter changeable. The spring of 1782 was

remarkably late, the hedges in some parts of England not being full blown till June. In May the weather throughout Europe was singularly disturbed, gloomy, cold, and humid. Dr. Darwin observes, that the sun was for many weeks obscured by a dry fog, and appeared red as through a common mist. In Bedfordshire, according to Dr. Hamilton, the temperature of the 22d of May was one degree lower than that of the 22d of the previous December. On the 2d of January the thermometer at St. Petersburg rose during the night from five degrees below to thirty above zero, and in the morning, in that city alone, 40,000 persons were affected with influenza. For three months previously to the occurrence of the epidemic, in the midland counties of England, scarcely a day had passed without rain; and the outbreak of the disorder was preceded by thunderstorms presenting remarkable phenomena:— "The lightning consisting of balls, which struck against each other, and threw out sparks; and although the thunder was distant, houses were burnt, trees shattered, and several persons killed." It must however be acknowledged, that remarkable variations of temperature during the prevalence of the disorder did not appear materially to influence the severity or frequency of the attacks.

The influenza of 1803, which was nearly as extensive as that of 1775, advanced in a northerly direction. Several solitary cases occurred previously, but the disease did not prevail as an epidemic in England till February, when it appeared in Sussex; it entered Nottingham in March, Yorkshire in April, and Durham in May. France and Holland suffered before England. North-easterly winds, thick, fœtid, acrid fogs, vivid appearances of the aurora borealis, and sudden atmospheric changes, had been previously observed, and in some countries shocks of earthquakes were experienced. In England the fields were covered with immense numbers of insects, and disease prevailed among horses, cows, sheep, swine, dogs, and cats. In France the disorder was often followed by ophthalmia, and in America by dysentery; many children who were the subjects of the complaint had dilated pupils, itching of the nose and anus, and mucous evacuations containing worms. Pneumonia was also a frequent complication, and bleeding was often found necessary. In some subjects dimness of vision attended the complaint, and remained even after the recovery of strength. One patient, for four days, saw objects three times multiplied. In this epidemic those who lived in sheltered situations, as in prisons and infirmaries, frequently remained free from the disease. The boarders in schools often escaped, provided they were not exposed to the north. One of the most striking instances of the influence of exposure is related by Dr. M'Can of Armagh, who mentions, that of 400 soldiers in barracks only eight were affected, while a large proportion of those billeted in the country suffered severely. Many interesting particulars of this epidemic are recorded in the account published by the London Medical Society. Dr. Fothergill, who wrote an excellent account of this visitation, considered the malady contagious.

In September, 1830, the disease again appeared at Manilla; it attacked some parts of Britain in the spring of 1831, but did not reach others till the autumn. Remarkably thick fogs, and great variations of weather, had been observed for some months previous to its appearance. This epidemic was widely diffused, prevailing both in the East and in America. In Warsaw, as well as in many parts of Britain, it preceded the epidemic cholera. The characteristic symptoms were, tenderness of the scalp, and cramps of the legs and arms. Towards the subsidence of the epidemic, diarrhœa and dysentery occurred, and formed a transition to cholera. Cough and debility continued long afterwards.

In 1833 the epidemic cholera was followed by influenza, which made its first appearance at Java, and attacked more than the influenza of 1831. It was more acute, and left less cough than the ordinary visitations of the malady. The distinguishing symptom was severe headach. Those who died generally

had cerebral symptoms at an early period. According to Dr. Fife, of Newcastle, bleeding was generally found injurious.

The influenza, as it occurred in England in 1836-7, is fully described in the *Trans. of Prov. Med. Assoc.*, vol. vi., that society having made laudable efforts to obtain information respecting the complaint, from all parts of the country. The weather prior to the occurrence of the disorder had been extremely unsettled. From the 22d to the 25th of December, 1836, there was a fall of temperature of twenty-five degrees, and a quantity of snow followed, perhaps unexampled in this country. Snow fell also in Palermo, Lisbon and Canton. On the 2d of January a thaw set in, and thick fogs prevailed during the month: the general outbreak of the disorder occurred at the commencement of the thaw: easterly winds prevailed, and the aurora borealis was frequently visible: a great many dead flies were found on the surface of ponds. It is remarkable that the malady existed simultaneously at Sidney and the Cape of Good Hope, and on the shores of the Baltic. Half the population were attacked in London, Hamburg, and Copenhagen.

The symptoms for the most part corresponded with those described at the commencement of this article as generally characterising influenza, particularly feverishness, pain and weight of forehead, tingling and acrid discharge from the nostrils, soreness of the fauces, hoarseness, cough, dyspnœa, far exceeding the degree of attendant inflammation, and great general depression. In some parts of the country, particularly at Salisbury and Aylesbury, rheumatism, neuralgia, and rheumatic neuralgia, were frequent complications. In some cases inflammation of the membranes of the brain occurred, in others inflammation of the spinal cord. Pneumonia was a frequent accompaniment, and when it was relieved by bleeding, the original disorder pursued its usual course. The head was in some patients attacked with pain, resembling neuralgia of the branches of the fifth pair of nerves. The pain was remittent, never distinctly intermittent, and sometimes yielded to arsenic. Spontaneous ptyalism occasionally occurred. Dr. Fife and a few other practitioners mention, as an occasional occurrence, enlargement of the parotid glands. From an interesting statement by Dr. Clendinning (*Med. Gaz.*, vol. xix.) it appears, that of 157 complicated cases (constituting three fifths of those recorded by that accurate physician), 36 had pneumonia, 52 bronchitis, 25 phthisis, 25 fever, 5 pleuritis, and 14 suffered from other affections. Of 40 severe cases related by Dr. Macleod, 3 had laryngitis, 3 pleuritis, 4 otitis with purulent discharge, 4 inflammation of the fauces, 2 swelling of the parotid and submaxillary glands, 1 inflammation of the conjunctiva, and 3 had erysipelas on the subsidence of the other symptoms. The membranes of the eyes were less frequently affected in this epidemic than in that of 1833. Some patients were seized with sudden insensibility; many were affected with agonising fears of death. Syncope was produced by the removal of a small quantity of blood, and in some instances occurred spontaneously. A state of collapse, resembling that of cholera, was occasionally observed. Relapses were frequent, requiring more active treatment than the primary attack, and often attended with violent pain between the umbilicus and symphysis pubis. It was observed that children suffered much less severely than adults, excepting during the period of dentition. The victims to the disease among elderly persons had been for the most part previously subjects of bronchitis, or disease of the heart; and, among the middle-aged, of phthisis. The fatality of the complaint was also considerable among those affected with asthma or pertussis, or who had just recovered from eruptive diseases. The deaths, as far as could be ascertained, were about two per cent. on the number attacked, a proportion corresponding with that deduced by Ozanam from a calculation of the mortality of all the recorded instances of epidemic catarrh. During the epidemic of 1836 it was generally thought, that free exposure to the weather lessened the liability to the disease.

We may deduce from the preceding account that, since medical records have become available, influenza has prevailed on an average once in ten years.

and has proved the most destructive of epidemics. There is also reason to believe, that a modified condition of the atmosphere may remain for years after the prevalence of the disease, and occasion a liability to affections of a similar character, to which the term influenzoid might be applied. For eight years after the prevalence of influenza at Lyons, this was found to be the case, 1300 deaths out of 10,096 occurring during that period, being attributed to catarrhal or mucous fevers. We are inclined to believe, that a similar condition has existed in this country since the epidemic of 1833, affections of the bronchi and fauces having been unusually prevalent, associated with severe muscular pains and unusual depression of strength. If this be the case, the subject is one of great importance, and well-deserves special investigation.

Diagnosis. Bronchitis is perhaps the only disease with which influenza can easily be confounded. The former affection, however, is generally induced by atmospheric changes, and attacks the predisposed; the latter has comparatively little reference to changes of weather, affects all individuals nearly equally, and is attended with more local pain and general debility than is proportionate to the severity of the catarrhal symptoms.

Nature of the disease. Uncomplicated influenza rarely destroys life, and the appearances detected in the bodies of those who have died while suffering from the malady, have been usually the relics of some associated disease. In the few cases of death which have occurred from simple influenza, the following are the chief appearances which have been observed:—The mucous membrane of the larynx and bronchi has been found of a deep red colour, flakes of lymph have been sometimes observed on the chordæ vocales and in the ventricles, and the trachea has been injected and covered with glassy-looking mucus; the lungs surcharged with serous and mucous fluid, and having portions of their lower lobes engorged and sometimes consolidated.

The danger, in extreme cases of influenza, appears to arise from an excess of mucus preventing the due arterialisation of the blood. The difficulty and rapidity of respiration are, however, out of all proportion to the quantity of secretion, or even to the amount of inflammation, and the dyspnœa is sometimes intermittent: and this circumstance cannot easily be explained except by supposing that the cause of the disease must operate, by producing an impression on the vital energy of the lungs, analogous to that occasioned by cutting the nervus vagus: and we may reasonably conjecture that influenza depends on an influence exerted on the nervous system, especially on that part of it having most relation to the bronchial mucous membrane, tending to elicit any latent predisposition to disease, and modified in its character by varieties of constitution as well as by peculiarities of climate and other external conditions.

This opinion derives support from the liability, so frequent in this complaint, to derangement in a great variety of organs, as well as from the occasional occurrence of inflammation of the spinal chord, and of inflammation or other affections of the brain. The effects of such a shock thus communicated to the nervous system may be expected to develop themselves in the weakest organ, and to vary according to collateral circumstances. Thus, in the same epidemic, one patient will suffer from meningitis, another from enteritis, a third from rheumatic affections. If a sudden increase of temperature succeed to frost or snow, pneumonia will frequently be found associated with the complaint, whilst exposure to fatigue and mental anxiety will increase the liability to erysipelatous complications.

Sources of the epidemic. In entering on this inquiry, it is necessary to recall some of the most prominent circumstances which have attended the progress of the disorder: and although most of the accounts which have been given abound in discrepancies, partly arising from real diversity in the phenomena, partly from the preconceived opinions of those who have written on the subject, we shall still be able to select several particulars in which nearly all observers concur.

The course of influenza is singularly analogous to that of epidemic cholera. It almost invariably travels in a westerly direction, and from the south towards the north. In proceeding from the east, it passes through Russia and the north of Germany to England, and then turns round through France and Spain to Italy. When arising in the south, its course is from Italy through Spain, France, Britain, and the Netherlands. The average period during which the disease rages in any place is generally six weeks. When specific inquiries have been made to ascertain the truth in this respect, as in Cheshire in the epidemic of 1782, and throughout England in that of 1836, the results have confirmed this statement, which rests on the concurrent testimony of a very large majority of authors: a partial outbreak of the epidemic has, however, frequently occurred a week or more previously to its general prevalence in an affected place. This circumstance was frequently remarked in the visitation of 1836, particularly at Stratford-on-Avon, Chester, and Southampton.

There are circumstances recorded making it appear probable that the atmosphere of a district in which catarrhal fever has recently prevailed is sometimes so modified as to be capable of producing the disease in visiters some weeks after it has ceased to rage among the inhabitants. For example, in 1782, a family arriving in London from the West Indies, two months after the cessation of influenza, became affected with the disease; and at Liverpool in 1837, the crews of ships arriving from America were often attacked two months after the inhabitants of the place had become proof against the epidemic influence.

Some visitations have most severely affected persons of the sanguine, and others those of the phlegmatic temperament: in some instances those most exposed to the weather have suffered most, in others the reverse has been the case; and it is agreed that no constitution or condition is at present known capable of securing immunity from this all-pervading malady. One of the correspondents of the London Medical Society (*Mem. Lond. Med. Soc.*, vol. vi.) mentions that no case of the disorder occurred in a workhouse near Reigate, where 200 were employed in the manufacture of blankets; and he seems inclined to attribute their escape to the free use of oil in the preparation of the blankets: but we need not have recourse to such an explanation, since many other instances occurred during the epidemic, in which persons living in sheltered habitations remained free from the malady. Probably the most remarkable and inexplicable case of exemption which has been recorded, is that mentioned by Mr. Greenhow, of 300 women engaged in coal dredging in the sea at Newcastle.

We now proceed to inquire how far the different theories regarding the origin and extension of the epidemic can be reconciled with acknowledged facts; and we shall particularly notice among the alleged causes of its origin or extension, contagion, atmospherical vicissitudes, the diffusion of foreign substances in the atmosphere, and electrical conditions.

Cullen designated the disease *Catarrhus contagiosus*, and many other authors have attributed its prevalence to this cause: but epidemics into which contagion enters as an important element, for the most part advance slowly, attack masses in succession, and affect different classes of the community at different times. The diffusion of influenza over a whole country is occasionally so rapid as to be absolutely inexplicable on the doctrine of contagion, which is also inadequate to explain its frequent extension among the lower animals, having no communication with one another. The theory of contagion is also incapable of explaining the occurrence of the disease in ships at sea, of which several remarkable instances occurred in the epidemic of 1782: for example, in the Atlas, East Indiaman, between Malacca and Canton; in the ship of Admiral Kempenfelt, whilst cruising between Brest and the Lizard, and in the fleet of Lord Howe off the coast of Holland, these vessels in every instance having put to sea some weeks before influenza appeared at the ports from which they sailed. On the other hand it must be acknowledged, that the dis-

ease occasionally attacks the members of a family in succession, after the manner of a contagious malady. It is also true that, in many instances, when an individual affected with the disease comes from a distance to any place, the inhabitants of the house he visits are often the first attacked. This was particularly observed at Norwich and St. Alban's in 1782. (Dr. Hamilton, in *Mem. of Med. Soc.*) Dr. Haygarth obtained specific information regarding the same epidemic as it occurred in ten of the towns of Cheshire; and in seven instances of the ten the first cases presented themselves in houses at which travellers had arrived from affected places. A similar observation was made in the last visitation. (*Trans. of Med. Prov. Assoc.*) Such evidence is too forcible to be altogether disregarded, and we therefore incline to the opinion, that this disease may be occasionally propagated by personal intercourse. At the same time we should consider this mode of communication incidental and occasional, not essential, and should place influenza very low in the scale of contagiousness.

Another cause which has been assigned for the production of this remarkable disorder is great atmospheric vicissitudes of temperature or humidity, and the prevalence of particular winds. We have been careful to relate the most important phenomena having reference to this inquiry; and at first sight there appears to be some evidence in favour of the theory of sudden changes of temperature, north-easterly winds, thick fogs, and other indications of an unsettled state of atmosphere having been present in numerous instances. The comparative mildness of the complaint in sheltered dwellings has been frequently noticed, especially in the epidemic of 1803; and a remarkable circumstance is mentioned by Dr. Carrick, rather favourable to the explanation under review. On Clifton Hill is a range of building called Richmond Terrace, forming three sides of a parallelogram, respectively fronting east, south, and west. During the prevalence of influenza in 1803 scarcely an individual residing in the side fronting the east escaped the disorder, whilst a majority, both of persons and families living on the south side, remained entirely free from the malady. We may add that the disease has prevailed most frequently in severe weather. Of 56 epidemic seizures in Europe, 22 have been in winter, 12 in spring, 11 in autumn, and 5 in summer. There is, however, too much evidence of an opposite character to allow us to be satisfied with this explanation. The disorder has prevailed in every climate, at almost every season, and during every variety of wind and weather. In 1580 it raged during a sultry autumn; in 1830 at Manilla in the month of September, during a temperature of from 78 to 92 degrees; and in 1836 it existed at the same time in Cape Town and London, the season being midsummer in the one place and midwinter in the other. Vicissitudes of temperature, damp weather, and melting snow have often existed to a great extent without inducing influenza, although they have a decided tendency to produce catarrhal, bronchial, and pneumonic affections, and when present during the prevalence of influenza to superinduce such complaints as complications.

The theory which refers the cause of the malady to the diffusion of some noxious matter through the air demands consideration. It may not be irrelevant to observe, that spots upon linen and other articles, resembling those occurring from leprosy, have been noticed during the prevalence of cholera and plague, and that such appearances give a plausible aspect to the idea that some tangible material is engaged in the production of such epidemics. It cannot be denied, that minute substances diffused through the atmosphere occasionally produce effects in some respects analogous to influenza. Cases are related (*Rust's Mag.*, and *Lond. Med. Gaz.*) in which urgent dyspnœa, spasmodic cough, dryness of fauces, quickness of pulse, and great debility, were produced by inhaling the powder of ipecacuanha: in one of these cases the symptoms were aggravated by bleeding. The production of hay-asthma by the odoriferous particles of the vernal grass, may be adduced as additional evidence of the possibility of such an occurrence. If, however, the epidemic could be referred to such a cause, the uniformity in the period of its continuance in any

place it visits would lead to the impression, that the cause must be liable to gradual development and decline, and therefore be organised. The observations of Ehrenberg have proved the abundant prevalence of animalcules in our atmosphere, and it is not improbable that vegetable germs may also abound in it. The supposition is allowable, that such organised matter, if existing, may suffer modification, more or less extensive in quantity or condition under the influence of magnetical or other changes, which may alter the relation of the atmosphere to living beings, and by engendering or diffusing some peculiar virus become a source of disease. Such an idea is however purely speculative. Facts approaching nearer to the character of evidence may be adduced in favour of the opinion, that mineral impregnations adequate to produce analogous disorder may exist in the atmosphere. It is difficult to suppose, that the same mineral deterioration could arise in every variety of soil; but the difficulty may be slightly diminished by assuming a volcanic origin. Berzelius, after inhaling a small quantity of seleniuretted hydrogen lost the sense of smell, and suffered from catarrh, suffused eyes, and cough, for many days. Dr. Prout has ingeniously remarked, that some combination of selenium may be diffused through the atmosphere and produce epidemics. (*Bridgewater Treatise*, p. 357.) This substance is often associated with sulphur in volcanic emanations, and there appears to have been a connection between the acrid dry fogs which often preceded or accompanied influenza, and volcanic eruptions, especially in the year 1782. Even the grosser kinds of volcanic matter may be thrown to a considerable extent. In January 1835, for example, dust was carried in the opposite direction to the wind, and therefore evidently in a counter-current, from Coseguina in Nicaragua to Chiapa, a distance of 1200 miles; and it is easy to suppose, that gaseous emanations may spread still more widely through the air. At the same time it must be allowed, that the systematic duration of the complaint for a certain number of weeks, and the similarity of its violence in all parts of the world, is unfavourable to this hypothesis.

The electrical theory remains to be noticed. M. Weber was so firmly convinced of the dependence of the complaint on a negatively electrical state of the atmosphere, as to recommend for a preventive socks made of non-conducting materials, such as oiled silk, or paper covered with sealing-wax. Dense isolated clouds in a state of negative electricity have been occasionally observed at the commencement of epidemics. Influenza has often been preceded by violent storms, and in the years 1775 and 1803 meat exposed to the atmosphere was rapidly tainted; circumstances rather favourable to the assumption of a connection of the epidemic influence with electrical conditions. It is true that this theory is not at first sight consistent with the systematic duration of the complaint, and that the observations of Volta did not detect any electrical changes in the atmosphere of affected places. Still the science of electricity is not sufficiently advanced to enable us to decide against this view; and the singular exemption of the coal-dredgers at Newcastle, exposed continually to a conducting medium from standing in the sea, is favourable to the modification of the electrical hypothesis entertained by Dr. Schweich, who appears to attribute the disease to a condition of atmosphere favourable to the production of accumulated electricity in the animal body. (*Die Influenza, &c.*)

The uniformity of the course of influenza from east to west, thence turning round to the south, may be conceived to intimate some connection with magnetic currents; and it is not improbable that magnetical conditions may have some effect in predisposing the system to the morbid influence, or in modifying the causes on which the malady may essentially depend.

Treatment. Notwithstanding the general analogy presented by different visitations of influenza, there is yet so great a variety in the prominent symptoms of any visitation, that our experience of one is an insufficient guide to the treatment of another. Indeed in any single epidemic the derangements of health produced in different subjects are so diversified, and our knowledge of

the organic changes on which they depend is so incomplete that we cannot reduce the plan of treatment to a systematic form. An attempt to divide the disease into different stages and to fix the appropriate treatment for each, would lead to unnecessary refinement, rather than conduce to practical utility; and it will probably be sufficient to speak of the management adapted to the complaint at its commencement, in its progress, and in its decline. In the slighter manifestations of the disorder we must confine our treatment to the mildest measures. A careful regulation of the diet may be alone sufficient. When the employment of remedies is expedient, we believe that too much importance cannot well be attached to the use of mercury followed by an aperient at the onset of the malady. In a considerable proportion of cases, a dose of calomel combined with compound extract of colocynth, followed by a saline purgative, will be found of signal utility, obviating congestion, diminishing the liability to local inflammation, and rendering the subsequent affection milder and more transient. In many instances a single dose of the remedy seems to accomplish the object; in others it may be once or twice repeated on alternate days with advantage. Even when some degree of intestinal irritation is present, mercury in a milder form may usually be administered. Under such circumstances, mercurial pill combined with an anodyne extract, as that of hemlock or henbane, may be employed, and for subsequent use castor oil will be the most suitable aperient.

In a few cases without the previous adoption of this plan, and in nearly all after its employment, more especially if the skin is hot and the pulse frequent, it will be desirable to confine the patient to bed, and administer mild diaphoretics. Perhaps the most appropriate remedy of this class is acetate of ammonia, which may be combined with ipecacuanha if a mild expectorant is required; and if there be much attendant irritation of the bronchial tubes, with antimonial wine. In cases accompanied with any degree of crepitating rhonchus, a few leeches may usually be applied with advantage. The complication of pneumonia is that which most frequently renders bleeding expedient, but as in the pneumonia of typhus, this measure must be employed with caution. The state of the pulse materially assists in determining the question. Ozanam mentions, that of fifty-two epidemic catarrhs which have prevailed in Europe, bleeding was found useful in thirty-nine, hurtful in ten, and useless in three. In every visitation of influenza there are instances in which this measure may be requisite; but as the disease has appeared in Britain, with the exception of the epidemics of 1775 and 1803, the cases requiring its employment have been comparatively rare; and it may probably be admitted as a general rule, that inflammation associated with influenza should be treated less actively than when uncombined. This rule applies even to the complication of pleuritis and of pericarditis. When pain of the frontal sinuses, or cerebral symptoms, are distressing, a few leeches applied to the Schneiderian membrane often give material relief. When convulsive cough is present, hydrocyanic acid is a suitable remedy. Ipecacuanha combined with oxymel of squills may be administered if the cough is unattended with expectoration. If, as commonly occurs in those who are subject to asthma, there is congestion of the bronchial mucous membrane characterised by sonorous and sibilous rhonchi, ætherial tincture of lobelia inflata may be administered according to the recommendation of Dr. Llakiston. Having found this remedy useful in chronic bronchitis, he was induced to try it in influenza, the dose being from ten minims to half a drachm diluted with two ounces of water. He considers it a narcotic, acting on the organs of circulation through the nervous system, and controlling the quantity of blood sent to the lungs. Alkalies may be combined with the lobelia if the bronchial secretion be tenacious and difficult of expectoration. In cases partaking of the character of suffocative catarrh, mustard poultices should be applied, and senega with ammonia and paregoric, or, in some instances, the Lobelia inflata. Ammonia is peculiarly adapted to cases of profuse bronchial secretion, associated with depression of nervous energy.

In some extreme cases, acetate of lead has proved singularly efficacious in checking inordinate secretion from the bronchial tubes. When there is remarkable slowness of the pulse, either spontaneous or produced by treatment, brandy may be given with advantage, and the cordial plan may be continued so long as it improves the pulse without increasing the cough. In the decline of the affection, in cases which have materially involved the bronchi, copaiba will be found useful in improving the secretion and correcting the morbid condition of the mucous membrane; and where a more stimulating expectorant is requisite, as in the old, and in cases which have assumed any degree of the suffocative character, ammoniacum and squill may be preferred. In the later periods of such affections, opium is a useful auxiliary; but, notwithstanding the sanction of some eminent practitioners, we believe its premature use to be hazardous, calculated to check secretion, and often to induce inflammation. If restlessness at night be distressing, and tincture of henbane prove inefficacious, morphia may be given with advantage. Should bilious diarrhœa occur mucilaginous drinks, sometimes combined with laudanum, are indicated, and emetics if there is nausea or vomiting. In these cases the state of the tongue affords us much assistance in determining on the plan of treatment. If it be covered with a thick fur, especially if the bowels are confined, purgatives are requisite, but if it be preternaturally red and the epigastrium be tender, demulcents, counter-irritants, and even leeches to the epigastrium should be employed.

When a febrile condition continues, associated with much debility, and especially if presenting phenomena of an intermittent character, quinine and Battley's solution of the yellow bark are eligible remedies.

Sequelæ. We have no conclusive evidence that phthisis can be absolutely produced by influenza, but it is indisputable that previously existing tubercular disease may be called into activity by it. Chronic bronchitis and asthmatic affections are frequent consequences of the malady, and are often found very obstinate. It is remarkable that the severity of the sequelæ bears no proportion to the violence of the attack of influenza. Thus after the mild visitation of the year 1762 a peculiarly severe and fatal dysentery prevailed.

It should not be forgotten that influenza perhaps, through the medium of a shock communicated to the nervous system, often leaves a state requiring considerable and prolonged attention. Even when no particular disease is superinduced by the attack, the mind and body do not for a considerable time recover their ordinary energy; fatigue is easily produced; there is increased liability to bronchial affections, perhaps a morbid condition of the membrane of the nostrils; greater susceptibility of the mucous membrane of the intestines to irritating medicines, or to injudicious diet, and of the skin to atmospheric vicissitudes; and if the patient have been previously subject to neuralgic or rheumatic affections, or to cutaneous eruptions, they will be easily reproduced. In such instances, simplicity of diet, cool rooms, change of air, diminished amount of intellectual labour, the shower bath, and the general adoption of a mildly tonic plan, will be requisite.

ASPHYXIA.

Preliminary observations. — Causes. — Phenomena. — Anatomical characters. — Nature. — Treatment. — Strangulation. — Anatomical characters. — Treatment. — Submersion. — Anatomical characters. — Treatment.

The literal meaning of this term (according to its derivation from ἀ priv. and σφύξη, pulse) is a loss or suppression of the pulse, indicative of a failure in the action of the heart, constituting what is now known as *Syncope*. It is,

however, universally employed at present to designate the cessation of the function of respiration (or rather, of its essential part, the aëration of the blood), and the consequent suspension of the heart's action.

Preliminary observations. In order to have a clear idea of the pathological condition thus indicated, — of its causes, nature, and results, — it is necessary to take a brief survey of the character of the respiratory process, and of its connection with the other vital functions, especially those of circulation and nutrition. This process essentially consists in the interchange of ingredients between the blood and the atmosphere, when brought within the sphere of each other's action in the organs adapted to the purpose. There is, on the one hand, an extrication of carbonic acid from the circulating fluid; and, on the other, an absorption of oxygen from the atmosphere. Although these are not the only changes which take place in the process of aëration, they are the most important to the present inquiry, from their immediate necessity to the continued well-being of the animal. The nutritive fluid, by its circulation through the capillaries of the system, undergoes great alterations both in its physical constitution and vital properties. It gives up to the tissues with which it is brought in contact some of its most important elements; and, at the same time, it is made the vehicle of the removal from these tissues of ingredients which are no longer in the state of combination that fits them for their offices in the animal economy. To separate these ingredients from the general current of the circulation, and to carry them out of the system, is the object of the excretory organs; and it is very evident that the importance of their respective functions will vary with the amount of the ingredient which they have to separate, and the deleterious influence which its retention will exert on the welfare of the system at large.

Of all these injurious ingredients, carbonic acid is without doubt the most abundantly introduced into the nutritive fluid; it is also most deleterious in its effects on the system, if allowed to accumulate; and we accordingly find the provision for its removal surpassing in importance that made for any other excretion. The two largest glands in the body appear to have for their chief object the separation of carbon from the blood; but this operation is subservient in each case to other purposes. By the liver this element is combined with others into a fluid excretion, which has important uses in the digestive function; whilst by the lungs (which may be certainly regarded as organs of a glandular character) it is excreted in a gaseous form, and thus made subservient, according to the laws of the mutual diffusion of gases, to the introduction of oxygen into the system, and the consequent maintenance of the animal temperature as well as of the stimulating properties of the blood.

It is evident, then, that any circumstances which check the excretion of carbonic acid by the lungs, will have an immediately injurious effect upon the system at large, by causing the accumulation in the fluid upon which it is dependent for the performance of its vital actions, of an agent that so seriously injures its vivifying properties. But this is not the only mode in which the cessation of this function is injurious. The exclusion of a constant supply of oxygen from the blood, even though the removal of the carbonic acid were provided for by other means, deprives it of its due power of nourishing and exciting to action the tissues and organs to which it is afterwards distributed; for it would appear that this element is, throughout animated nature, a stimulant as necessary to the energy of its operations, as caloric is to all, and light to many of these. Further, we shall hereafter see reason to believe that any obstruction to the due aëration of the blood has an immediately injurious effect upon the circulation, by causing a retardation or even an entire cessation of its movement through the capillaries of the lungs; and, in consequence, a dangerous accumulation of blood in the venous system, with a proportional deficiency in the arterial.

We observe, accordingly, that a provision for these changes is more uni-

versally found to exist in living beings than for any other function, save the ingestion of aliment, and the perpetuation of the race. Even in plants a true respiration analogous to that of animals is constantly going on, although its effects are sometimes obscured by the converse change which is subservient to a different purpose. (*Principles of general and comparative Physiology*, p. 294.) In the lower animals the process is carried on by means which render it equally independent of any active movements adapted expressly to the purpose. In proportion to the energy and variety of the nutritive processes, however, does the necessity arise for a more powerful and constant respiration; and we find in the warm-blooded *Vertebrata* the highest activity of this function provided for by the vast extension of the aërating surface, and by the means adapted to renew both the blood and the air in contact with it. The arrangement of the circulating apparatus is such, that *all* the blood which has been returned from the system is made to pass through the lungs, before being again transmitted through the aorta — a provision which is not made for any other gland, the portal circulation presenting the nearest approach to it. And, on the other side, the nervous and muscular systems are adapted to keep up, without the intervention of the will of the individual, a constant series of movements, by which the air that has been vitiated is replaced by a pure supply. Although these arrangements will be fully explained in the physiological division of this work, it is necessary here to advert to the mode in which these constant changes are maintained, in order that the operation of various causes in the production of asphyxia may be rightly understood.

The periodic movements of the heart, by which the blood is propelled into the capillaries both of the system and of the lungs, result, there is good reason to believe, from the simple contractility of its muscular structure, excited by the direct application of a stimulus. Experiment seems to have sufficiently demonstrated that, although they may be influenced by particular conditions of the nervous system, they are not dependent upon any constant influence transmitted through it, as was formerly supposed. Like other muscular structure, the parietes of the heart may be excited to contraction by stimuli of various kinds; but that which is employed in the living body is the contact of blood with the membrane lining its cavities. So long as the fibre retains its vital properties, will this stimulus excite it to contraction; but if it be deficient, and not replaced by any other, no movement will take place. In those cases in which the movements of the heart have continued for many hours after it has been removed from the body, it is probable that the admission of air to the interior of its cavities has acted as the stimulus. Over-distension of the muscular tissue appears to suspend for a time its contractility; and this effect may even be produced by the accumulation of blood in excessive quantity, which prevents the fluid from exercising its usual stimulant influence.

On the other hand, the movements of the respiratory muscles are entirely dependent upon the influence of the nervous system. Their ordinary actions are of the class denominated by Dr. M. Hall *excito-motor*, and were spoken of by Whytt and other authors as *sympathetic*. They result from a stimulus originating in the extremities of the nerves usually denominated *sensory*, but which may be more properly called *afferent;* and this, being conveyed to the spinal cord, occasions the propagation along the motor or *efferent* nerves of an influence which excites the muscles to action. The afferent or excitor nerves most concerned in producing the respiratory movements are the pneumonic portion of the par vagum, and those which supply the surface of the face and body. The impression of the external air on the skin (itself in some degree a respiratory organ) seems to be the stimulus which acts through the latter; and it is in this manner that the first inspiration of the infant is excited. The presence of venous blood in the lungs has usually been considered as the stimulus which acts through the par vagum; but Dr. M. Hall contends, with some apparent justice, that it is the evolution of carbonic acid which is to be

regarded in this light. However this may be, it is admitted on all hands that, after the function is once actively established, the impression of the *besoin de respirer* conveyed by the pneumogastric is the principal source of the continuance of the movements. From the recent experiments of Dr. J. Reid (*Edin. Med. and Surg. Journ.*, April, 1839), it appears that, although they will continue after section of these nerves, they are much diminished in frequency. The great interchange of filaments which has been proved to take place between the pneumogastric and the sympathetic, joined to certain "residual phenomena" brought to light by experiment, leaves little doubt that the latter system of nerves also is concerned in the maintenance of the respiratory movements, its function being perhaps supplementary to that of the pneumogastric. We may suppose also, without much improbability, that the *besoin de respirer* may be produced by impressions transmitted from other parts of the system as well as the lungs, when imperfectly arterialised blood is transmitted through its capillaries; just as the sense of hunger seems to depend, not only upon the emptiness of the stomach, but upon the demand for nutrition existing in the body at large. It will be observed that the two most powerful excitors of these actions, the pneumogastric and the fifth pair, terminate in the medulla oblongata; and that the motor nerves by which the most important of them are called into play arise in their neighbourhood. Hence respiration may continue when the portions of the nervous centres, both above and below this division, have been removed, which has caused it to be regarded as the peculiar seat of life.* A little consideration will show, however, that it is so only by furnishing the mechanical conditions requisite for the real organic function of respiration, to which the inspiratory and expiratory movements are but superadded actions properly forming part of the animal functions. We are now prepared to consider the causes which may operate in the production of asphyxia.

Causes. The variety of conditions required for the healthy performance of the function we have been considering, involves a similar diversity in the causes which may produce its suspension. These may, however, be classed under two general divisions: the *first* comprehending those which mechanically prevent the contact of the aëriform medium surrounding the animal with the membrane lining the lungs; and the *second* including those which affect the chemical processes to which this contact is subservient.

I. This division embraces a great variety of causes, which must be separately considered.

1. Those which suspend the respiratory movements, by interrupting the nervous circle through whose agency they are maintained. Thus, section of the eighth pair of nerves on each side may induce asphyxia, though slowly, by suspending the transmission to the medulla oblongata of the stimulus originating in the lungs. If no other excitor nerves existed, there can be little doubt that this operation would suspend the usual respiratory movements as completely as section of the motor nerves themselves, though they might still be performed by an effort of the will; but the other excitors, which have been already specified, have sufficient power to maintain these actions, although with far less than the normal energy and regularity. The asphyxia of new-born infants arises from the want of a sufficient impression upon these superadded excitors, by which the first inspiration is occasioned; as is shown by the effect of the stimulus of cold air on the face, or of the smart stroke of the palm on the body, in producing this essential movement. The nervous chain may be also interrupted at the point of communication between the afferent and efferent nerves, namely the spinal cord. Any want of integrity in the portion of this central organ which is included between its

* In the class *Tunicata* there is but a single ganglion, and this seems almost entirely devoted to the maintenance of the respiratory movements; so that Nature may be regarded as here presenting the physiologist with an anticipation of the above experiment. (See the author's *Prize Thesis on the Nervous System of the Invertebrata*, p. 51.)

connections with these nerves, will obviously impede the transmission of the necessary influence, as completely as lesion of the nerves themselves. This is by no means unfrequently exemplified in the effects of disease or accidents to which this part is subject. Thus, fracture or dislocation of the upper part of the cervical vertebræ may produce compression or laceration of the cord above the origin of the phrenic nerve. In this case all the respiratory movements of the trunk are immediately suspended, except those produced by the spinal accessory nerve, which are by no means alone sufficient to maintain the constant exchange of air which is required; and death, therefore, very rapidly supervenes. If the affected part of the cord be below the origin of the phrenic nerve, but above that of the intercostals, life may be prolonged for some time; but a slow asphyxia appears to take place, since death generally occurs at an interval of from three to seven days. (Sir A. Cooper, *on Dislocations, &c.*) The same effect will result from want of functional activity in this portion of the nervous centres, although no disease or injury may have directly affected it. Thus, in the ordinary apoplectic coma, as in profound sleep, the functions of the medulla oblongata being but little impaired, the respiratory movements continue almost as usual; but if, by compression or other deleterious influence, it should become less able to respond to the stimulus communicated to it by the excitor nerves, the movements will cease more or less gradually, and the aëration of the blood will be consequently prevented. A similar condition may result from the operation of narcotic poisons, by which the functional activity of the whole nervous system, but more especially of its central organs, is depressed, and the respiratory movements in consequence suspended for want of the maintaining power. Section of the motor nerves will of course produce a corresponding effect. If the phrenic be divided, respiration may be carried on for a short time by the intercostals, but not in a degree sufficient for the prolongation of life. If the intercostals be divided, the animal will respire with difficulty and imperfectly, as when the spinal cord is injured above their origin; and slow asphyxia is usually the result. There is a difference among different species, however, as to the degree in which the movements of the diaphragm and those of the thorax are respectively concerned in producing the ingress of air. In birds it is entirely dependent upon the elevation of the ribs, no complete diaphragm existing in that class; and paralysis of the intercostal muscles, by the division of the spinal cord above their nerves, consequently produces immediate asphyxia. In fishes, on the other hand, the respiratory movements can only be affected by injuries of the medulla oblongata, as all the nerves concerned in them arise from that division of the spinal axis.

2. The next group of causes to be enumerated is composed of those which prevent the dilatation of the thoracic cavity by mechanical compression of the exterior of the body. Instances are by no means rare in which persons engaged in excavating are suddenly overwhelmed by a fall of earth which closely envelopes the body, leaving the head free. If not speedily relieved from such a situation, the sufferer dies of asphyxia; since the descent of the diaphragm is prevented by the compression of the abdomen, as well as the ascent of the ribs by the restraint to which the thorax is subjected; and the first shock expels the contents of the lungs, and reduces the cavity to its smallest dimensions. A curious case is mentioned by Dr. Roget (*Cyc. of Prac. Med.*, vol. i. p. 177.), in which a similar result was very near occurring to a pugilist, of whose body a cast was being taken in one piece. As soon as the plaster began to set, he felt deprived of the power of respiration; and, to add to his misfortune, was cut off from the means of expressing his distress. His situation, however, was perceived just in time to save his life. The due expansion of the thoracic cavity may also be prevented by accumulation of fluid or the growth of tumours in the abdomen, by which the descent of the diaphragm is impeded; but though a very distressing amount of dyspnœa often results from this cause, it is not likely ever to produce absolute asphyxia. Any disease which occasions a very

painful condition of the contents of the abdomen, such as acute peritonitis, will offer a similar impediment to the movements of the diaphragm; as will inflammation of the pleura or pericardium, or rheumatism of the external muscles, to those of the thorax.

3. Asphyxia may take place from disorder of the mechanism of respiration, without the existence of any force externally compressing the thorax, or of any direct impediments to the entrance of air into the lungs. These organs may be prevented from dilating by an accumulation of fluid in the pleural sacs; or by the admission of air into the thoracic cavity, either through its parietes, or through the lungs. If an aperture be made into the cavity on one side, so that air rushes in at each inspiratory movement, the expansion of the lung on that side will be diminished or entirely prevented in proportion to the size of the aperture. If air can enter more readily than through the trachea, an entire collapse of the lungs will take place; and if such apertures be made on both sides, asphyxia necessarily results. But if they are too small to admit the very ready passage of air, the vacuum produced by the inspiratory movement will be more easily filled by the distension of the lungs; so that a sufficient amount of change takes place for the maintenance of life. Sudden death by asphyxia not unfrequently occurs from a communication being opened by disease between the air-passages and the pleural cavity, so as to check the dilatation of the lung of that side, whilst the function of the other is impeded by tubercular deposition, hepatisation, or some other morbid alteration of its structure.

4. The next group of causes is a very numerous one; and those which it includes, although operating upon the respiratory process in the same manner, are very different amongst themselves. It is composed of those which interfere with the admission of air into the air-cells (where alone it is brought into relation with the blood), either by altogether preventing its entrance into the passages, or by obstructing its movement through them. The entrance of air into the trachea will of course be prevented by any means which produce occlusion of the orifices that lead to it—the mouth and nostrils. If these be obstructed by any solid substance applied closely upon them, death is said to take place by *suffocation*. If the face be immersed in water, so that air can gain no admittance to these openings, asphyxia is said to be produced by *submersion*. It is obviously immaterial whether the whole body be covered with water or not; many drunkards have been drowned (so to speak) in a puddle, from which they had not sense enough to withdraw their faces; and many infants have been prevented from making the first inspiration by the immersion of the mouth and nostrils in the pool formed by the maternal discharges, or by the occlusion of these entrances by their own membranes. Air may gain admittance to the mouth and nasal passages, and yet be prevented from passing into the trachea, by meeting with some obstruction in the larynx. The rima glottidis may be closed by the œdema resulting from acute inflammation, or by the thickening which is produced by more chronic disease; or it may be constricted by the spasmodic affection which so often accompanies these states, and which sometimes occurs independently of them, from irritation of the nervous system by other causes; or it may be closed in consequence of paralysis of the dilating muscles, as Dr. H. Ley believed to occur in laryngismus stridulus.* Obstacles

* The pathological explanation of this disease given by Dr. Ley was founded upon the supposition, that the *dilators* of the rima glottidis are supplied by the recurrent laryngeal nerve, whilst the constrictors of that opening are stimulated by the superior laryngeal branch. He thence inferred that, if the functions of the former nerve were impeded by the pressure of enlarged glands or other causes, and the muscles which it supplies be consequently paralysed, the constrictor muscles would close the rima glottidis for want of opposition. The more recent experiments of Dr. J. Reid (*Edin. Med. and Surg. Journ.*, vol. xlix.), however, have shown that the superior laryngeal is almost entirely a sensory nerve, and that the recurrent is almost exclusively motor, supplying both constrictor and dilator muscles. He states that "severe dyspnœa amounting to suffocation may arise both from *irritation* and *compression* of the inferior laryngeal nerves, or the trunks of the pneumogastrics. For when both or even one recurrent nerve was irritated, the arytenoid cartilages were approximated, so as in some cases to shut completely the superior aperture of the glottis." (p. 149.) When the recurrents are cut or compressed, the arytenoid cartilages are no longer separated during inspiration; and their move-

to the admission of air into the lungs may also exist in the trachea; the aperture of which may be closed by external pressure, as in *strangulations*, or its lining membrane may be so much tumefied by disease as nearly to prevent the passage of air. The accumulation of secretions, too, which the patient has not strength to expectorate, may occasion asphyxia; and the same result sometimes occurs in croup, from the obstruction presented by the formation of a false membrane, which is often of considerable thickness. The pressure of tumours upon the trachea will often produce asphyxia, which has been the immediate cause of death in many cases of aneurism, and in some of bronchocele. In such cases this condition gradually supervenes; and the difficulty of respiration is indicated by the livor of the countenance and the dilatation of the nostrils, for a long time previous to the termination of life. Sometimes, however, an aneurism or abscess will burst into the trachea, and occasion immediate death by suddenly obstructing the access of air to the lungs. A frequent cause of asphyxia is the presence of foreign bodies within the air-passages, or even in the pharynx. In the former case they may occasion speedy death, even though not of sufficient size to produce material obstruction to the passage of air by the irritation they excite: during a fit of coughing they may be driven up against the rima glottidis, which they may mechanically obstruct; or they may occasion spasmodic closure of this orifice by reflex excitement of the laryngeal nerves. The increased secretion also, which results from the irritation, adds to the mechanical impediment; so that, from a combination of these causes, death by asphyxia often supervenes where at first no material obstruction to respiration appeared to exist. The lodgment of large masses of solid matter in the œsophagus, as when an attempt is made to swallow hard substances which are too bulky for its calibre, will sometimes produce immediate asphyxia, as if by strangulation; or, if a partial obstruction only be created, the difficulty may be fatally aggravated by the spasmodic action which is excited, as in the last case. These are the most frequent causes of obstruction to the entrance of air through the larynx and trachea. The bronchial tubes also may be similarly affected; but the amount of impediment thus created in the respiratory process will depend upon the proportion of the pulmonary structure which the particular tube supplies. A foreign body obstructing one of the passages into which the trachea primarily divides, will of course impede, more or less completely, the respiratory action of the corresponding lung, and may thus induce slow asphyxia, which will be aggravated by the spasmodic actions to which the irritation of its presence gives rise. But if it should find its way to one of the smaller passages, no immediately fatal result would probably occur; though diseased action would probably be excited in its neighbourhood, which might ultimately terminate life. Several instances are on record in which such an occurrence has seemed to be the remote cause of death. A fatal result may, however, be speedily occasioned by causes which affect the bronchial tubes only, if it involve them universally or nearly so. Thus it may take place from the accumulation of secretions or fluid effusions, which prevent the entrance of air to the air-cells, even though it freely pass through the trachea. This is very apt to occur as a consequence of a congested state of the pulmonary vessels brought on by other causes; and it aggravates this very condition by the new obstacle it opposes to the respiratory process, and to the movement of blood through the capillaries. Such a state may be artificially induced by section of the pneumogastric nerves; but it also supervenes, to a greater or less extent, on many pulmonary diseases. Perhaps we may include,

ments become so completely passive, that they are carried inwards by the current of entering air, which they consequently impede, whilst they are separated again by the expiratory blast. "We shall leave it," continues Dr. R. "to those who have had frequent opportunities of seeing this disease to determine which of these two causes, irritation or paralysis, will best explain its phenomena. There appears, however, to be little doubt that the crowing respiration and dyspnœa, which accompany some cases of hysteria, depend upon a spasmodic closure of the glottis, produced by some irritation of the recurrent nerves."

under this class of causes, spasmodic constriction of the bronchial tubes, which seems to be an impediment to respiration in some forms of asthma: the existence of such a state is, however, uncertain; and no experimental proof has yet been given of the power of nervous irritation to produce it. It is, however, the only feasible mode of accounting for some of the phenomena of this disease.

5. Supposing the air necessary for respiration to have obtained free admission through the trachea and bronchial tubes, asphyxia may still take place from the lungs themselves being in an unfit state to allow the due action between their gaseous contents and the blood. Various morbid alterations of their structure, which it is needless to specify, may thus prove fatal, and this, either rapidly or slowly, according to the progress of the disease. Thus pulmonary apoplexy, a pneumonia of a few hours' duration, and a deposition of tubercular matter which has been proceeding for years, may occasion death in the same manner. It is thought by some that, independently of any change of structure, the lungs may be functionally unfit for the aëration of the blood, through a disordered supply of the "nervous influence" which is required for the process; but sound physiology does not warrant us in the belief that any such influence is necessary: nor is there any solid reason to believe that this function can be affected by any cause that does not produce a change in the physical conditions which are evidently essential to its performance.

Having thus taken a general review of the principal causes which operate by *physical* means in the production of asphyxia, we may consder,

II. The causes which affect the *chemical* processes, to which the physical conditions are only subservient. These may be briefly dismissed. Of the several gases which may be introduced into the lungs, there are but a small number capable of producing simple asphyxia. Most of them have an immediately deleterious action on the system, quite independent of their negative properties, which consist in their want of power to afford oxygen to be absorbed or to remove the carbonic acid that is to be excreted. Hydrogen and azote are almost the only gases which can be regarded as simple asphyxiating agents. Both these may be breathed for some little time with impunity, even by man; and cold-blooded animals will exist in them for several hours or even days. By their physical properties they are enabled to remove the carbonic acid from the blood nearly as energetically as common air can do; but as they afford no oxygen, the animal must sooner or later perish for want of this stimulus. Oxygen breathed alone, however, is very deleterious to the system, which it over-stimulates. Other gases act as true poisons on the system, when introduced into it through the lungs; and their effects, therefore, are of a complex nature.

Phenomena. These vary, to a certain degree, with the *cause* of the suspended aëration of the blood; nevertheless, there are some which are universally witnessed, and to these our principal attention will be directed. They may be best observed when the asphyxia is *gradually* produced, as by a partial obstruction of the air-passages; when it *suddenly* comes on, they succeed one another so rapidly as not to admit of accurate observation. They may be divided into three stages. The *first* commences with an increase of that natural *besoin de respirer*, which prompts to the ordinary acts of inspiration; and this increases until it amounts to a sensation of extreme distress. In respondence to this extraordinary stimulus, active and powerful inspiratory movements are involuntarily performed; and muscles are excited to contraction, which do not partake in the ordinary duty. Other instinctive movements, more remotely conducive to the relief of the sufferings experienced by the individual, are sometimes performed by him at this time. The distress, which soon amounts, if not relieved, to intense agony, is of short duration; though it lasts longer if the aëration of the blood continue to a slight degree, than if the process be entirely suspended. It gives place to vertigo and a feeling of stupidity, which soon increases to absolute insensibility, which may be regarded as characterising the *second* stage. The respiratory movements

now become irregular and convulsive; and the other instinctive movements assume a similar character, the whole frame now partaking in them. Lividity of the countenance may sometimes be observed at the end of the first stage; it rapidly increases in the second, and especially affects the lips, which are often of a deep purple. The veins also become turgid; and the eyes are injected, and seem as if ready to start from their sockets. At this time the heart is found to be pulsating languidly, and the pulsation at the wrist is almost imperceptible. Very shortly all the animal functions are suspended; no further muscular movements are performed, nor are any capable of being excited. The sphincters give way; and the animal, if previously erect, falls completely powerless. This is the *third* stage. The heart continues for a time to contract feebly; but the aëration of the blood is entirely suspended, and sufficient fluid is not propelled by it into the aorta to produce sensible pulsation of the arterial trunks. The general surface now partakes of the livid tint which first showed itself in the face; the hands and feet presenting a violet hue, and patches of a similar colour existing in other parts of the skin. The organic functions do not entirely cease until the circulation of the blood has been completely suspended; and even after somatic death must be regarded as having taken place, the temperature of the body is very slowly dissipated, and the *post mortem* rigidity of the muscles tardily supervenes. In fact recovery may take place even after the heart has ceased to act, if the proper means be employed.

The relative intensity of these phenomena will be affected by the cause to which they owe their origin; as will also, in some degree at least, the order in which they present themselves. The preceding description applies especially to those cases in which the deprivation of air is sudden and almost complete, as when due to an obstruction existing in the air-passages. It is in these that the inspiratory efforts are most laborious, and the sense of distress the greatest. Where, however, the cause be such as puts a stop to the muscular movements concerned in respiration, the fatal termination more rapidly comes on, and there is less of general disturbance. When the asphyxia is more gradually induced, on the contrary, the sufferings are often most distressingly prolonged. Thus, where it supervenes as a consequence of pulmonary disease, the dilated nostrils and livid cheek often indicate for a protracted period the existence of deficient aëration, whilst the patient's complaints of dyspnœa but too truly correspond with these symptoms. The feeling of distress is often referred to the lower part of the sternal region; and we have known counter-irritants applied to the spot with the view of relieving it, when the real malady was situated in the larynx. It is a point, therefore, of considerable practical importance, not to be hastily led to infer from local sensations the cause of the difficulty of respiration; this it may frequently exercise the skill of the physician to detect. It is when asphyxia slowly supervenes as a result of disease, that the greatest irregularity in the order of the symptoms is observable. A very high degree of lividity often shows itself long before the stage of insensibility has come on; and the latter is often preceded by symptoms of irregular action of the brain, such as vertigo, tinnitus aurium, flashings of light before the eyes, and various spasmodic actions. The subsequent convulsive movements are less violent; and the lividity of the face never acquires so deep a tint, although the discoloration is more general over the body. In these cases the action of the heart usually ceases soon after the respiratory movements have come to a stand; and this is the mode in which life very commonly terminates.

The time which is necessary to destroy life by asphyxia varies much, not only in different animals but in different states of the constitution of the same. Thus, warm-blooded animals are much sooner asphyxiated than reptiles or invertebrata; and, on the other hand, an hybernating mammiferous animal supports life for many months with an amount of respiration sufficiently low to produce speedy asphyxia if it were in a state of activity. And among

mammalia and birds there are many species which are adapted, by peculiarities of conformation, to sustain a deprivation of air for much more than the average period. Excluding these, it may be generally stated, that if a warm-blooded animal in a state of activity be totally deprived of respiratory power, its muscular movements (with the exception of the contraction of the heart), will cease within five minutes, often within three; and that the circulation generally fails within about ten minutes. Many persons, however, are capable of sustaining a deprivation of air for three, four, or even five minutes, without insensibility or any other injury; but this power, which seems possessed to the greatest degree by the divers of Ceylon, is only to be acquired by habit. The period during which remedial means may be successful in restoring the activity of the vital and animal functions, is not, however, restricted to this. Cases are not unfrequent of the revival of drowned persons after a submersion of half an hour; and more than one has been credibly recorded in which above three quarters of an hour had elapsed. It is not improbable, however, that in some of these cases a state of syncope had come on at the moment of immersion, through the influence of fear or other mental emotion, concussion of the brain, &c.; and that, the circulation being thus enfeebled, the deprivation of air had not the same injurious effect as when this function was in full activity, just as in the case of an hybernating animal. Such a state has been denominated syncopal asphyxia. The reanimation of still-born infants has been successfully attempted when nearly half an hour had intervened between birth and the employment of resuscitating means; and when probably a much longer time had elapsed from the period of the suspension of the circulation.

Anatomical characters. In cases where death has resulted from simple asphyxia rapidly induced, the external appearances found on subsequent examination are usually very characteristic. The general lividity of the surface is not unlike that which is observed on the depending parts in other cases, but may be distinguished from it by not being confined to these situations. Moreover, it is often further characterised by the presence of deeper spots, resembling those of ecchymosis. These are most commonly seen in the face and neck of persons who have been hung or strangled; and, on the other hand, they are usually absent in cases of drowning; but they are occasionally seen under other circumstances. The appearance seems to be the result of congestion of blood in the vessels of the skin, from which, indeed, the fluid appears sometimes extravasated; numerous points being observable when a section is made into the substance of that tissue. The features usually retain the expression of distress, and the eyes, as already noticed, continue prominent; the pupils are dilated, as in coma.

The accumulation of blood in the right side of the heart, and in the vessels connected with it, namely, the systemic veins and the pulmonary artery, and the comparatively empty state of the left cavities, as well as of the pulmonary veins and systemic arteries, are the appearances most characteristic of asphyxia; and they are constant when this state has been completely developed. They are best marked, however, where it has slowly terminated life; especially when some degree of aëration has taken place up to its close, and the action of the heart has ceased within a short time. The coronary veins may often be observed to exhibit an extraordinary turgescence. Not only may the venous congestion be noticed in the vena cava and larger trunks, but it is very perceptible in all organs which are largely supplied with blood. Thus, the liver and spleen are in a state of engorgement; and the blood may be forced out in large drops by slight compression of their parenchymatous tissue. The intestinal membranes, too, are observed to be excessively congested, especially in the most depending parts; and ecchymosed spots are not unfrequently seen on the mucous membrane of the stomach after strangulation, constituting a variety of pseudo-morbid appearance, which the inspector will do right to bear in mind. This tendency to congestion in the venous system, which so constantly accompanies deficient respiration, has a most important influence on

the condition of various organs in the later stages of chronic diseases of the thorax; and it readily explains the derangements which they are liable to exhibit. Even the heart not unfrequently suffers from the same cause; a permanent distension of its right ventricle, with hypertrophy of its walls, being a frequent concomitant of obstructed respiration; of which particular instances will be hereafter given.

The blood is usually found fluid, or but imperfectly coagulated, if the asphyxia have been rapid; and this corresponds with what is observed after other kinds of sudden death. Where it has more slowly supervened, the blood coagulates as usual.

The veins and sinuses of the head of course partake of the general venous congestion; and, in well-marked cases, an unusual number of red points are seen on slicing the brain. The distension is greatest where the previous struggle has been most severe, or where there has been a peculiar obstruction to the return of the blood from the head, as in hanging or strangulation. There is seldom, however, any morbid effusion; but an apoplectic extravasation is sometimes found, though rarely as a consequence of simple asphyxia. In cases where there has been but little general disturbance, the vessels of the brain and its membranes are found to be in their natural state.

The venous congestion is usually well marked in the root of the tongue, which often appears as if injected, the papillæ being remarkably prominent. It extends also to the mucous membrane of the larynx and epiglottis, of the trachea and bronchi, which is deeply coloured by vascular turgescence, and which becomes darker as it is traced into the smaller ramifications of the bronchi. The mucus which covers its surface is generally mixed with a frothy serous exudation, usually exhibiting a sanguinolent tinge. This effusion, which is often very abundant where the obstruction to the respiration has gradually operated, seems to result from the congested state of the vessels, and not to be an altered form of the natural secretion, as some have supposed. The fibrous tissue which unites the cartilaginous rings of the trachea and bronchi is also injected with blood. The lungs themselves, if not previously diseased, are greatly distended, and expand so as to meet over the pericardium. When exposed to view, they present a dark brown, sometimes almost blackish, hue externally; but their parenchyma exhibits a redder tint when cut into. The engorgement is here in the arterial system; but it is occasioned by the accumulation of venous blood, of which large dark, thick drops flow out when incisions are made in the substance, and slight pressure employed.

Pathology of Asphyxia. There can scarcely be a more remarkable illustration of the important truth that morbid anatomy furnishes but one class of the facts upon which the science of pathology must be erected, than that presented to us in the inquiry which we have now to make into the nature of the morbid action which results from the derangement of the respiratory function, and the mode in which this occasions death. There is no dispute as to the leading facts supplied by anatomical examination; but in the interpretation of those facts there is much scope for discussion. No satisfactory conclusion can be attained, unless a clear conception be first formed of the physiological or normal action of the organs whose deranged function is the subject of investigation. We particularly refer to that of the capillary vessels of the lungs, the duties of which must, it is obvious, be the first deranged by any cause which obstructs the access of air to the respiratory membrane. It is in these vessels that the character of the blood is altered from the venous to the arterial; and to be subservient to this change is their peculiar function, just as the secretion of fluid is the function of the capillaries of glands, and nutrition that of the capillaries of the system in general. That the movement of the blood through them is principally dependent, in their usual condition, upon the action of the heart, does not admit of a doubt; but it seems equally certain that for the continuance of this movement, the continuance of the changes to which it is subservient is essential; and that not even the powerful contrac-

tions of the heart can force the blood into the pulmonary veins, when these changes are suspended. The condition here assigned to the maintenance of the capillary circulation does not apply to that of the lungs alone. It corresponds with that which we find by observation and experiment to hold good in reference to the capillaries of the whole system. We need not imagine that any mechanical propulsory power exists in them, in order to understand how such an influence on the movement of the blood through their canals may be exercised by their parietes; since it is easy to conceive that new attractions and repulsions between the solid and fluid particles may be created by the processes to which they are subject. This is not the place to discuss such a question, however; the correctness of the view just stated, in its application to this particular topic, will, we think, appear from the facts to be presently adduced; and a fuller elucidation of it will be found in the physiological division of this work. If its validity be assumed, it will follow that the first effect of impeded respiration will be a retardation or cessation of the passage of blood through the capillaries of the lungs; and that this impediment will be the cause of all the other phenomena which are observed in the progress of the complaint, and finally of its termination in death. Before proceeding to develope this view in detail, however, it will be desirable to glance at the principal theories which have been offered as explanations of the same facts, and to inquire briefly into their value.

It would be scarcely necessary to mention the doctrine propounded by Haller, since it received a most complete refutation from Goodwyn, were it not that he assigned the true situation for the commencement of the morbid changes, although he misunderstood their nature. In his opinion, the stagnation of the blood commenced in the capillaries of the lungs, and thence affected the whole venous system; but he imagined this stagnation to arise from a *mechanical* impediment, produced by the cessation of the motions of the lungs themselves. It is a sufficient reply to this doctrine, that all the phenomena of asphyxia are as completely developed in an animal which is made to breathe azote, as in one which has been drowned or strangled; and it was pointed out by Goodwyn, that after the fullest expiration, the air-cells do not return to the state in which they were in the new-born child, but are sufficiently distended to permit the blood to circulate freely through them. In fact, as will be subsequently shown, any excess of distension is unfavourable to the passage of fluid through their capillaries. The theory of Goodwyn himself was, that whilst venous blood furnishes to the right cavities of the heart the stimulus which excites them to contract, the fibre of the left side requires a more powerful stimulus,—that of arterial blood; and in default of this, ceases to perform its functions in maintaining the systemic circulation, no longer contracting upon the blood returned to it from the lungs, when this has not been arterialised. This hypothesis, however ingenious, is inconsistent with several observed facts. Were it correct, the pulmonary veins and left auricle ought to be found loaded with blood, which is not the case. Moreover, the left side of the heart continues to contract upon blood which may almost be called venous, in hybernating animals, whose respiration is so trifling; and Bichât proved experimentally that venous blood might be injected into the left cavities of the heart, with the effect of exciting, not depressing, their action. He also ascertained that venous blood is propelled into the systemic circulation of an animal undergoing asphyxia; so that the doctrine of Goodwyn may be regarded as completely disproved. We do not mean to assert, however, that venous blood is as effectual as arterial in stimulating the left side of the heart; but that it is sufficiently powerful for the maintenance of the actions of that portion of the organ so long as it is supplied, is evident from the fact that its chief cavity and the vessels connected with it are never found to contain more than a comparatively small quantity of blood.

The theory of Bichât is the one which, until recently, has gained the most general assent; and there can be no doubt that it is partly based on truth.

That it does not accord with *all* the facts of the case, however, and cannot, therefore, be regarded as a satisfactory explanation, will presently appear. He ascribed the cessation of the circulation to diminished irritability of the heart, resulting, as he supposed, from the deleterious effect of its penetration by venous blood upon its vital properties, an effect which he proved this fluid to exert on the excitability of the nervous system. This doctrine, as well as that of Legallois (who supposed the irritability of the heart to be destroyed by the circulation of venous blood in the spinal cord), is open to the same objection as that already brought against the theory of Goodwyn; which is one that will apply to any theory which primarily refers the cessation of the circulation to want of power in the heart; namely, the empty state of its left cavities, and the renewal of its action, after it has entirely ceased, by a cause which does not immediately affect it. Bichât, indeed, foresaw these objections. Of the second he attempted to dispose by asserting that artificial respiration never renews the action of the heart when it has entirely ceased—a statement opposed by well-ascertained facts. Of the first, he has given no satisfactory explanation. Moreover, his opinion that the circulation of venous blood through muscles is destructive of their irritability, is contradicted by the experiments of Dr. Kay (*Treatise on Asphyxia*, p. 50.), who found that the exhausted irritability of muscles was restored when venous blood was made to circulate through them, but remained extinct if no fluid was transmitted. Some of Dr. Edwards's experiments also lead to a similar conclusion; namely, that venous blood, though less powerful than arterial in maintaining the vital properties of muscles, is by no means rapidly destructive of them.

That the first impediment to the circulation of the blood in asphyxia is occasioned by an obstruction to its passage through the pulmonary capillaries, might be inferred simply from the progressive accumulation of the fluid in the system of vessels, of which those channels form as it were the outlet; a phenomenon constantly observed in this condition, and more or less rapidly induced as the aërating process is more or less completely suspended. It has been maintained by some that the blood flows freely into the pulmonary veins, and is thence carried into the general current of the circulation, until its deleterious action has been exercised on the nervous centres; and that, from a sort of paralysis of the capillaries of the lungs, the flow of blood through them is *then* impeded. But this view is inconsistent with the fact of every-day occurrence, that a great degree of venous congestion may occur long before the blood in the arteries has become sufficiently loaded with carbon, and deficient in oxygen, to produce insensibility by its action on the brain. Moreover, the doctrine that "nervous influence" is essential to the flow of blood through the capillaries of the lungs, or of any other part, is a mere assumption, unsupported by physiological facts. On the contrary, the recommencement of the circulation through the capillaries of the lungs, when oxygen is brought in relation with them, *before* any alteration has taken place in the character of the blood in the vessels of the brain, sufficiently proves that it is in them and them alone that we are to look for the primary cause of obstruction, and the cause of the recommencement of the circulation. What, then, is the nature of their influence on the movement of the blood through them? That it is not mechanical is sufficiently proved by observation; for no regularly alternating contractions and dilatations have ever been seen by the microscope in these vessels; and the only mode in which a change in their caliber would seem to influence the current is by such relaxation as may give it free passage, or such contraction as may impede it. The latter state is the one which would seem primarily to result from the application of any stimulus, as is shown both by microscopic examination and by the experiments of Wedemeyer, who found that stimulating liquids injected into the arteries of living animals were much longer than mild liquids in finding their way into the veins. The state of relaxation is that which *paralysis* or *want of tonic action* would seem to produce; and it is therefore impossible to attribute to either of these causes the cessation

of the movement of blood in the pulmonary capillaries, which is consequent upon suspended respiration.

A more valid and consistent explanation may be found in the cessation of those changes to which the passage of the blood through the capillaries of the lungs is subservient. How the movement of the fluid is dependent on their continuance, it may not perhaps be easy to explain; but the fact seems well established by direct evidence, and coincides with what we know of the laws of vital action in general. In the lower animals, as in plants and in acardiac fœtuses, the circulation is almost entirely independent of any central propulsive organs, and is chiefly maintained by powers originating in the capillary vessels; and even where a distinct and powerful heart is developed, we find that the distribution of blood to different organs is governed more by the relative activity of the processes taking place in them than by any other cause. Any circumstance which peculiarly excites the nutritive or secretory actions of a texture or gland will occasion a determination of blood towards it, which is quite independent of any alteration in the heart's action; and on the other hand, any depression of their natural actions will produce a corresponding diminution in the amount of blood transmitted through them, with which the heart has no concern. The fact, then, seems to be, that any impediment to the arterialisation of the blood in the pulmonary capillaries will *of itself* impede its motion through them; and this in proportion to the completeness of the obstruction. It is quite true that when the access of air to the lungs is suddenly and completely checked, the circulation through them continues for some little time; and that blood of a partly venous character is transmitted into the systemic arteries. But it is to be recollected that a considerable quantity of air is contained in the air-cells of the lungs; and that it is not until this has been so far deprived of its oxygen and loaded with carbonic acid, as to be unfit to effect any change on the blood, that we should expect the movement to be entirely checked. Moreover, the alteration in the character of the whole mass of the circulating fluid is effected gradually, as might be inferred from the small proportion transmitted by the heart at each contraction; so that, if a small stream be drawn from the carotid artery of an animal undergoing asphyxia, it will be seen to become progressively darker, from the commencement of the suspension of the respiratory movements to the cessation of the heart's action. If, then, an interruption of the chemical changes effected in the pulmonary capillaries be the cause of the stagnation of the blood in them, a renewal of those actions ought also to renew the movement; and this it has been experimentally demonstrated to effect, in a sufficient number of cases, and under a great variety of circumstances, provided that the suspension have not been so prolonged as to occasion a loss of the vital properties of the organism. To these cases we shall presently return.

We may consider it sufficiently proved, then, that the stagnation of blood in the capillaries of the lungs is the primary effect of suspended aëration; and we have now to inquire into the mode in which this disturbance of the current of the circulation affects other organs, especially the heart and nervous system. It is very evident that the accumulation of blood in the right ventricle must soon become a mechanical impediment to its contraction; and the distension at last appears to impair or even destroy its irritability, just as in the case of the bladder. There is no doubt, however, that the permeation of its texture by venous blood will affect its contractility; but that it is still able to propel its contents, if the distension be slightly relieved, is shown by the recommencement of its action when the renewed movement of the blood in the capillaries of the lungs diminishes the engorgement of the pulmonary arteries, and by the effect of more direct evacuation, as will be presently noticed. The left side of the heart, on the other hand, gradually ceases to act from an opposite cause—the deficiency of blood. It has been proved by the experiments of Drs. Williams and Kay that its contractility is retained until after the pulmonary veins have ceased to return sufficient blood to excite its

action. When rabbits were asphyxiated by tying the trachea, it was found that the flow of blood from a divided artery almost ceased at the end of the third minute, and was entirely suspended at the fifth; yet "the left heart contracted spontaneously for a very considerable period longer." And when the left auricle was examined under similar circumstances, it was found that after a period of three or four minutes very little blood was returned by the pulmonary veins, though the heart still acted vigorously. "In general," says Dr. Kay, "the phenomena of the cessation of motion in the left heart in asphyxia are these:—a smaller quantity of blood is received into its cavities, and expelled for a time vigorously into the arteries; the ventricle meanwhile diminishes in size, as the quantity of blood supplied becomes less, until at length, although spontaneous contraction still occur in its fibres, no blood issues from a divided artery, and the ventricle by contraction has obliterated its cavity; after this, blood slowly accumulates in the auricle from the large vessels of the lungs; and its contractility continues for a very considerable period." (*Edin. Med. and Surg. Journ.*, vol. xxix. p. 46.; and *Treatise on Asphyxia*, p. 135.) So long as the contractility of the left ventricle is retained, although its movements may have entirely ceased, it may be excited to renewed action by a supply of the necessary stimulus; and thus it may be revivified, and the general circulation restored, by artificial respiration, which, by unloading the right cavities, and filling the left, furnishes the required conditions.

There is no difficulty, then, in understanding how the entire circulation may be brought to a stand by a cause acting immediately upon the capillaries of the lungs. We have next to inquire into the mode in which those phenomena are produced which indicate an affection of the nervous centres;—namely, the vertigo, delirium, spasms, and insensibility which mark the later stages of asphyxia. These have been usually attributed, and with much show of reason, to the circulation of imperfectly arterialised blood through the vessels of the brain and spinal cord. In most vertebrated animals we find a provision for sending to the head the most highly-aërated portion of the general mass of nutritious fluid. The provisions for this purpose are most apparent in the class of reptiles; but they are also peculiarly manifest in the embryo state of birds and mammalia. It is evident, then, that of all organs of the body, the nervous centres are the most dependent upon a constant supply of pure arterial blood, for the due performance of their functions. But the *quantity*, as well as the *quality*, of the circulating fluid seems to have an important influence. The brain is well known to receive a proportion of the whole amount of blood, far beyond that to which its relative bulk would entitle it; and any interruption to the supply is found to have an immediately injurious effect upon its functional activity. Thus, Sir A. Cooper has shown, that if the carotid arteries be tied, and the vertebrals be compressed, a state resembling syncope immediately supervenes. We may reasonably infer, then, that the insensibility of asphyxia may arise from the concurrent action of both these causes—deficient supply, and depravation of quality. The deleterious influence of the circulation of venous blood through the cerebral arteries was proved by an experiment of Bichât. He injected venous blood from the heart of one dog into the carotid of another, and insensibility was the result; but, on the other hand, it has been shown by Dr. Kay that large quantities of venous blood might be injected into the carotid arteries without producing more than muscular debility and lassitude, provided the injection be made slowly and cautiously, so as not to produce mechanical injury of the cerebral matter, by distension of the vessels. In one of his experiments (*op. cit.*, p. 195.) an accidental circumstance occasioned the employment of considerable force; the animal struggled, and its limbs quivered, but it seemed to recover for a time, though it remained feeble. It afterwards exhibited symptoms of lesion of the brain, and died at the end of ten days, from the effects of an abscess in one of the hemispheres. There is no difficulty, then, in accounting for the immediate insensibility produced by Bichât's injections. From the results of Dr. Kay's

experiments it may be inferred, that "though venous is a much less stimulating fluid than arterial blood, it may circulate through the cerebral mass without producing by its *contact* with the brain a sudden suspension of the functions of the nervous system. I conceive that it must be regarded as a fluid capable of only slightly nourishing and stimulating the nervous system. Its presence in the vessels of the brain, even for a short time, occasions languor and feebleness; and if its circulation were prolonged, we may imagine that sensation and voluntary motion would become still further impaired; but it does not destroy life by contact with the brain, and in asphyxia small quantities of it are transmitted, and for a short period only, to the cerebral structure." (*Op. cit.*, p. 198.) The sudden insensibility of asphyxia is, therefore, to be in part attributed to the rapid diminution in the amount of the blood sent to the brain; and a state by no means dissimilar is often witnessed in cases of hemorrhage, in which deficiency of the nutritious fluid is the *only* cause in operation: neither change alone would produce the train of phenomena formerly described; this results from a combination of both. We have already observed a similar combination of influences in the suspension of the heart's action; and our attention is thus forcibly directed to the fact that when any link in the chain of vital phenomena is broken, and the equilibrium of the whole disturbed, the derangements which ensue are so various and complicated, that it is difficult to assign to each its peculiar agency in finally producing the fatal termination.

It is obvious that the state of deep coma, once induced, will hasten death in those cases in which a small amount of respiration was previously going on, by the suspension of the muscular movements necessary to it. But even after this has supervened, and the *animal life* of the being has ceased to manifest itself, the organic life may be maintained for a considerable period; its duration depending upon the intimacy of the connection between the two classes of functions at the time. Thus, although the destruction of the brain and spinal cord (by which a state corresponding with profound coma is induced) occasions speedy death under common circumstances, Dr. M. Hall has shown that it may be performed in an hybernating animal, without extinguishing the heart's action, for many hours. Again, this connection cannot be said to be established in the new-born animal, until the first respiration has taken place; and before this has occurred, life may be prolonged for a considerable time under submersion in warm fluid. Thus Buffon found that greyhound puppies appeared to have suffered little, after being immersed in warm milk for half an hour; and Legallois found the mean duration of life in full-grown fœtuses of rabbits, immersed in water, to be twenty-eight minutes. After the animal has respired for a short time, however, this power of resisting the want of air diminishes very rapidly; and in those species which generate a large amount of heat soon after birth, such as the guinea-pig, this power is scarcely greater in the new-born animal than in the adult. These different conditions, natural to the lower animals, find a parallel, to a certain degree, in peculiar states of the human economy induced by disease, especially those in which syncope partakes.

When the causes of asphyxia were being enumerated, it was pointed out that it is the natural tendency of many internal diseases, as well as of various external agencies, to induce this condition. We may now go further, and state what will to many appear startling, that in a very large proportion of deaths, natural as well as violent, gradual as well as sudden, the event is either immediately or remotely attributable to this cause. It must be remembered that, so long as the circulation is maintained, the life of the system must be regarded as continuing, even though the animal functions should have ceased to manifest themselves; and if the causes which can operate in suspending this movement be considered, they will be found to act in one of three ways: either by destroying the moving powers, which have their seat in the heart and capillary vessels; by occasioning an obstruction in some part of the channel, which shall affect the whole current, and not a part of it merely; or

by withdrawing the vital fluid itself. In the first of these cases, death is said to take place by *syncope*; and the same term includes the last also. Few causes but *asphyxia* can operate in the second mode, since no stagnation of blood in any other organ than the lungs can suspend the general current of the circulation, and a similar effect could only be produced by a complete obstruction of the aorta or pulmonary artery. It is therefore desirable to review briefly the principal morbid conditions which terminate in death through the medium of asphyxia, as well as to notice others which the continuance of imperfect respiration would be liable to produce.

Of the former, one of the most common is the state denominated coma or stupor, which results from some change in the healthy condition of the brain and spinal cord. When this is profound, it suspends the respiratory movements, as formerly mentioned, by interrupting the channel through which the stimulus conveyed by the afferent nerves acts in producing them. All diseases and injuries which terminate in coma do in reality, therefore, occasion death by asphyxia. This principle is a very important one, since it leads us to take means for the maintenance of respiration when the cause of the stupor is temporary only;—an indication which has been successfully acted upon. Thus, Sir B. Brodie found that animals rendered insensible by narcotic poisons might have their lives preserved by artificial respiration, kept up until the functions of the brain were restored; and the same expedient has been practised with success on the human subject. Although it would be evidently useless where coma is a result of permanent organic lesion, it is by no means impossible that it might be successful in some cases of insensibility with convulsions in children, resulting from some temporary cause, which might subside if the circulation could be carried on for a sufficient length of time, especially if life were enough prolonged to allow of the operation of remedial agents. It must not be supposed, however, that all causes acting through the nervous centres produce death through the medium of asphyxia; since there are many which rather occasion syncope, depressing the general vitality of the system, destroying the contractility of the heart, and the peculiar properties of the capillaries, as by a sudden and general shock, which seems diffused through the nervous trunks to every part. It is in this manner that concussion, and other violent mechanical injuries to the brain, occasion the immediate cessation of the movement of the blood, which is not prolonged for an instant beyond the cessation of the movements of respiration. There is a form of apoplexy, the *apoplexia fulminans* of old authors, denominated by French writers *apoplexie foudroyante*, in which the effusion of blood acts instantaneously in the same manner as a mechanical shock; whilst the mode in which this disease ordinarily becomes fatal is by suspending the respiratory movements alone. It seems probable that when death results from exposure to cold, it is at last by asphyxia induced by coma. It does not appear very clear, however, to what the coma is to be attributed; nor is it certain that the injurious influence of cold as a sedative to all vital actions is not directly exerted in checking the circulation, by depressing the powers of the heart and capillaries. The connection of obstructed circulation through the lungs with diminished sensibility of the nervous centres, should not be forgotten in the consideration of the phenomena of fever. It is well known that in typhoid states of this disease, in which coma is threatened, dyspnœa is a very frequent occurrence, and that this is accompanied by a considerable effusion of fluid into the parenchyma of the lungs, without any decided symptoms of active disease in these organs. The continuance of this state will of course favour the complete production of coma; but a sound pathology will teach us to direct our remedial means rather towards the head than the chest.

The diseases which have a tendency to produce asphyxia by directly preventing the access of air to the blood have already been pretty fully indicated; but it must be remarked, that when these are very chronic in their form, they do not produce death by asphyxia simply, but by such a general wasting of

the powers which move the blood, that it may be said to partake of the nature of syncope. It is in cases of violent and sudden death that the distinctions above made are most easily recognised; the termination of protracted disease, if observantly watched, will generally present phenomena partaking of all the forms which may separately manifest themselves in particular cases. The intimate dependence of all the organic functions with one another, and the degree in which every one may be influenced by the nervous system, often cause them to be affected by disorder of any one, in a manner which at first sight appears anomalous, but which a little consideration will generally elucidate.

We have hitherto considered asphyxia only in its fully developed form, and examined only its fatal termination. It must not be forgotten that imperfect respiration has a tendency to produce various diseases, although it may not be sufficient for the immediate extinction of life. The recent experiments of Dr. J. Reid (*Edin. Med. and Surg. Journ.*, April, 1839) have shown that, when the number of inspiratory movements is greatly diminished by section of the pneumogastrics, the sanguineous engorgement of the lungs which is thereby produced is very apt to pass into the state of inflammation; and that the various stages of pneumonia, and even gangrene, are very commonly witnessed in animals which have lived sufficiently long after the operation for these changes to take place. The most constant result of this engorgement is an effusion of serous fluid into the air cells and passages, which, of course, adds to the difficulty of respiration. It may, then, be reasonably surmised that there is a tendency to similar morbid changes in other cases of obstructed respiration; and this has been noticed in a variety of instances. Thus, when foreign bodies have remained impacted in the air-tubes, but have not produced immediate suffocation, inflammation of the lungs is very apt to supervene: and bronchocele not unfrequently proves fatal in a similar manner, whilst the real obstruction is still inconsiderable, and does not excite attention as the cause of the disease. The permanent congestion of the pulmonary arteries, and the demand for increased propelling force, will often occasion hypertrophy and dilatation of the right ventricle; and the same congestion, extending to the systemic veins, may be the cause of many diseases in remote organs, especially the brain, liver, intestines, and kidneys. Dropsical effusions, also, are very liable to occur from the same cause. It is perhaps during the progress of phthisis that we most frequently observe these consequences of partial asphyxia. The bronchitis which so commonly accompanies chronic tubercular disease of the lungs may be not improbably regarded as taking its origin in the congestion of the mucous membrane of the air-passages, which has been mentioned as a constant result of obstructed respiration; and the attacks of active inflammation of the lungs themselves, which are so liable to supervene whenever deposition of tubercular matter has taken place, may, without doubt, be in part attributed to a similar predisposition. The diarrhœa which so commonly occurs in the later stages of the complaint may be accounted for in a similar manner. It is often found on *post mortem* examination that no morbid change has taken place in the mucous membrane of the alimentary canal or in the intestinal glands; and its functional disorder may be attributed to the irritable state induced by the congestion which has affected it during life, and which has been mentioned as often so remarkable a feature in the appearances found after death from asphyxia. Even where ulceration of the intestinal glands, and softening of the mucous membrane, are found to have taken place, they may be regarded as having had their origin in the disturbance of the circulation so often alluded to.

Treatment. The ideas which are entertained of the nature of asphyxia must necessarily have an important bearing upon the principles of treatment. Those which will be here stated have been for the most part fully sanctioned by experience; and will, at the same time, be found to harmonise well with the theoretical views formerly stated. It is rarely that this condition comes under the notice of the physician in any other form than as secondary to other diseases; but as he should not be ignorant of the share it

has in various kinds of *violent death*, we shall presently consider the principal forms under which it may present itself, and the treatment specially adapted to each.

The first object in the treatment of asphyxia will evidently be to remove its cause; since, as long as this continues to operate, no permanent relief can be procured by any means whatever. This precept will apply not only to the removal of direct or mechanical obstructions, but to the abatement of all sources of interference with any of the operations naturally concerned in the function, and especially those of the nervous system. When the derangement has not advanced so far as to occasion cessation of the respiratory movements, it will usually be found that this measure will restore the due action of the whole train in a very short time, provided that no organic lesion, such as extravasation in the brain, has taken place. But where these have been suspended, more active means become necessary. It will be remembered, that not only is there a suspension of activity under such circumstances, but an absolute diminution of the vitality or irritability of all the organs concerned, occasioned by the previously insufficient supply of blood, and by the want of oxygenation in that which has been last transmitted. The indications of treatment, therefore, are two; the renewal of the respiratory actions, and the excitement of the low irritability of the system by unusual stimuli. The first is effected by artificial respiration, which is undoubtedly the most powerful means in our possession of restoring suspended animation under such circumstances. Its success, however, will mainly depend upon the care and judgment with which it is employed. As little time as possible should be lost in putting this measure into execution; but whatever interval should from necessity occur, may be advantageously employed in other ways to be presently noticed. Until more appropriate means are available, the natural movements of respiration may be in some degree imitated, by compressing the chest and abdomen, so as to diminish the cavity of the thorax, and to expel from the lungs as much as possible of their contents, and then allowing them to recover their former dimensions by their natural elasticity. Although but a poor substitute for the natural process, even this trifling assistance may be of the utmost benefit, if given at the critical time when the heart's action is nearly suspended, and the vital powers rapidly sinking. Where no bellows can be procured, the insufflation of the chest from the mouth of another is the best measure that can be adopted. It would, in fact, be preferable, on account of the higher temperature at which the air is thus introduced, and the security which is afforded against the employment of an injurious degree of force, were it not for the partial carbonisation and abstraction of oxygen which this air has undergone. The insufflation is performed by applying the mouth of the operator to the mouth or to one of the nostrils of the patient, closing the other apertures, and making a forcible expiration, so as to dilate the chest which is then to be emptied again by gentle pressure. The insertion of a short tube into the nostril, if of sufficient bore, will much facilitate the operation. It will be desirable that an assistant should at the same time gently press the larynx backwards and a little downwards upon the vertebræ, so as to oppose the passage of air through the œsophagus into the alimentary canal. When a pair of bellows is employed, the air should be injected through one nostril, whilst the mouth and the other nostril are closed; the latter is then to be opened for the expiration of the air*, and the process repeated about fifteen times in the minute. With regard to the amount of air to be thus introduced at each stroke, there is some difference of opinion. Goodwyn, although he estimated the quantity naturally taken in at each inspiration to be no more than twelve cubic inches, recommended that a hundred cubic inches should be thrown in by the bellows, for the dislodgement of the impure air from

* The bellows constructed under the direction of the Royal Humane Society is provided with an additional valve for this purpose, which prevents the necessity of the alternate closure and unclosure of the nostril.

the air-cells and smaller bronchial tubes, which he thought could not be otherwise effected. There is no doubt, however, that if this principle were followed, irreparable injury would result from it to the texture of the lungs; indeed, there is reason to believe that many individuals have been sacrificed by injudicious insufflation who might otherwise have recovered. Leroy discovered that brisk inflation of air into the trachea killed rabbits, foxes, goats, sheep, and other animals, even when the force employed was that of an expiration from the human being; and the recent experiments of Dr. Southwood Smith (*Philosophy of Health*, vol. ii. p. 75.) have shown, that though a moderate inspiration favours the passage of the blood through the lungs, great distension of their cavity checks almost entirely the circulation of fluid through them, by the mechanical compression of the vessels. According to Leroy, the quantity injected ought to be the same as that naturally inspired; and this is the safest rule. A few repetitions of the process will soon produce an entire exchange of the air contained in the lungs, by the tendency to mutual diffusion of which all gases partake; and it is better that no risk should be run of doing mischief where the organs concerned are of so delicate a conformation. Moreover, the insufflation of too large a quantity of air will diminish rather than increase the development of caloric; and this is the explanation of the results which have led to the belief, that artificial respiration has no power of maintaining animal heat. The respiratory movements may also be excited by galvanic action on the muscles, in the method proposed by Leroy and approved by Magendie (*Journ. de Physiologie*, tom. ix.); and there can be no doubt that the penetration of a fresh atmosphere into the air-cells will be more facilitated by such a process, than by insufflation. This method requires little skill for its employment, and is unattended with any danger; and it is thereby superior to that of Dr. Ure, which can only be carried into effect by a person possessed of considerable anatomical knowledge. Leroy introduced acupuncture needles a short way into the fibres of the diaphragm on each side, in such a direction that they might be easily connected with the opposite poles of a galvanic battery. When the galvanic circle was completed, the diaphragm contracted and enlarged the cavity of the thorax: when it was interrupted, the weight of the abdominal viscera, assisted by gentle pressure on the surface, caused its return; and thus alternate movements of inspiration and expiration were produced, and maintained until the natural movements supervened. A small galvanic apparatus only is sufficient for this purpose.

The second indication for treatment is the exhibition of various stimulating agents, both internally and externally. Amongst the most powerful and useful of these is warmth; but some judgment is required in its application. If the circulation have ceased, and the temperature of the body be much lowered, no attempt should be made to raise it suddenly; since experiment shows that when such attempts are made on animals in a state of torpor, they are often fatal. Warmth may be gradually communicated by means of a warm bath, or by warm applications, especially to the region of the stomach; but no fluid of a temperature above 98° or 100° should be employed. Rubefacients also may be applied to the skin with advantage, and friction employed, when it has in some degree recovered its sensibility; but they are previously useless. Warm stimulating fluids in moderate quantity should be injected into the stomach or rectum, and stimulating vapours applied to the nostril.

When not only the respiratory movements but the actions of the heart have ceased, the case becomes much more serious, but it is not entirely hopeless. It has been already stated that artificial respiration has proved successful in renewing the circulation by unloading the right cavities of the heart and transmitting the necessary stimulus to the left. But this is unfortunately not often the case; and it is therefore to be considered what auxiliaries can be employed. Slight shocks of electricity, or a current of galvanism, transmitted through the region of the heart, would appear the most likely means of re-exciting its contractions. Another method has been pointed out, however,

which is well-deserving of trial. Professor Coleman found that after animals had been asphyxiated, and the right auricle had lost its irritability, the detraction of a small quantity of blood from one of its veins occasioned it in a few minutes to respond to the application of a stimulus. (*Wilson on the Blood*, p. 131.) A similar fact was observed by Dr. J. Reid in experimenting upon the action of certain poisons. A slight incision into the auricle itself appeared most effectual; but the opening of the jugular vein generally produced the same effect. This measure is likely to be useful in more ways than one, since it will relieve the congestion of the cerebral veins, and thus promote the recovery of the sensibility. It is not a step, however, to be indiscriminately adopted. The inquiries of Mr. King (*Safety-valve Function of the Heart*, in Guy's *Hospital Reports*, vol. ii.) leave us no difficulty in understanding how an abstraction of blood from the jugular vein may relieve the distension, not only of the right auricle, but of the ventricle, since the tricuspid valve does not close so as to prevent regurgitation, when the accumulation of blood is considerable. The effect of an electric or galvanic stimulus should be first tried; and if it fail, the experiment should be repeated after the abstraction of a little blood from the jugular vein as low in the neck as possible.

Attempts at resuscitation should not be abandoned as hopeless until many hours have elapsed, unless evident indications of death present themselves; nor should the employment of remedial means be discontinued at too early a stage of recovery. The condition of the patient, even after the natural movements of respiration have recommenced, and the circulation has been renewed, is very precarious, and requires watchful attention for a considerable time. Many lives have been sacrificed by too early neglect.

The object of the preceding sketch has been rather to give a general view of the whole subject of asphyxia, and especially to exhibit the connection of this pathological state with other morbid conditions of the system, than to pursue any department of it into details.

We shall now inquire how far it is concerned in two of the most common forms of violent death,—strangulation and submersion: these, however, will be here considered simply in a pathological view; their juridical relations will be fully treated of in the division of this series appropriated to forensic medicine. One form of asphyxia which has been but slightly adverted to in this article, the *Asphyxia neonatorum*, will be more fully treated of among the diseases peculiar to infants.

We shall now consider the phenomena attending certain forms of *violent death*, in the production of which asphyxia is principally or solely concerned.

Strangulation. By this term is understood forcible compression of the neck by a ligature, to such an extent as to impede or prevent respiration. *Suspension* is, therefore, but one variety of strangulation, the peculiarity of which consists in the traction of the ligature being produced by the weight of the body. In the simplest form of suspension, the phenomena are precisely the same as those of ordinary strangulation; this takes place where the body is lifted from the ground by traction of the cord, and where no violent jerk is given to the neck. But this seldom happens; for in most cases of suspension the body has been made to fall more or less violently, so as to occasion other injury besides the simple compression of the neck in which strangulation properly consists. We shall first, then, consider the phenomena of death by *strangulation* simply; and afterwards those which often attend death by *suspension*.

If the compression of the neck affected only the trachea, it is obvious that death would be produced by asphyxia solely; and in this manner it has been occasionally brought about,—some firm substance, like the cushion of a tourniquet, having been applied upon the windpipe. A mode in which infanticide has been sometimes perpetrated—the firm and continued pressure of the thumb upon the trachea—operates in precisely the same manner, although

hardly referrible to the head of strangulation, from the absence of ligature. On the other hand, it is easy to conceive that a ligature may be applied around the neck in such a manner as to make injurious pressure on the jugular veins, so as to occasion death by cerebral congestion, or by apoplexy simply, without materially obstructing the respiration. And again, it is sufficiently evident that, in most cases of strangulation, both these circumstances will operate in producing the fatal result. Accordingly it is found, by examination of the bodies of those who have died by strangulation, that in a few cases the signs of asphyxia alone are present; in some those of apoplexy alone are very decided; and in a large proportion the appearances indicate that both states have existed. Out of 102 cases collected by Remer (*Annales d'Hygiène*, tom. iv. p. 179.), unequivocal signs of apoplexy were found in nine; the appearances resulting from pure asphyxia in six; a combination of the two in sixty-eight; and in the remaining nineteen the proximate cause of death was not substantiated. More recently Dr. Casper (*Wochenschrift für die gesammte Heilkunde*, January, 1837) has given a similar collection of the results he has obtained, of which the following is a summary. Out of 106 cases, death appears to have taken place by apoplexy in nine; by simple asphyxia in fourteen; by both conditions in sixty-two; from neither in five; and the number of unexamined bodies was sixteen. In several of the cases attributed by Remer to apoplexy, there seems to have been (although not distinctly stated by him) an extravasation of blood in the brain, as well as congestion of the cerebral vessels: in those related by Casper, on the other hand, the congestion alone seems to have been too much relied on as a sign of apoplexy, since it is to be recollected that distension of the veins of the brain occurs in asphyxia. It can scarcely be doubted that these variations depend principally on the mode in which the ligature is applied to the neck; and a series of experiments upon his own person was performed by Dr. Fleischmann (*Annales d'Hygiène*, tom. viii. p. 432.), with the view of elucidating this question. Although not entirely satisfactory, they afford some important results, of which we shall give an abstract.

1. If the neck be encircled with a ligature placed *between the chin and the os hyoides*, so as to rest upon the sides and angles of the lower jaw, the principal vessels are but slightly compressed, and the cord may be drawn tightly without any material impediment being offered to the respiratory actions. After a short time, however, a flushing of the face and a prominence of the eyes are perceived; the head becomes unusually hot; a sensation of weight is perceived in its interior, which increases to great oppression almost amounting to insensibility; and a noise in the ears suddenly commences. When this symptom developes itself, M. Fl. remarks, it is high time to give up the experiment, as a few moments longer would be fatal. The compression may, however, be borne for as much as two minutes with impunity. There is evidently a tendency to the production of apoplectic congestion; but the vessels are not sufficiently compressed for this condition to be immediately induced. The account given of these sensations by persons who have recovered after suicidal, accidental, or experimental suspension (instances of the last being by no means unfrequent), does not materially differ from that just quoted. A peculiar feeling of a pleasurable nature is first experienced; then imperfection of the sight, with flashings of bluish light; and these are rapidly followed by insensibility. 2. Similar consequences will follow the application of the ligature *upon the larynx*; but here the respiration is more impeded. Scarcely half a minute expires before the noise in the ears, and a sensation in the brain which it is difficult to describe, give warning that the experiment must be discontinued. It is obvious that, in this position of the cord, the vessels are no longer protected by the angles of the jaw, and will therefore be more completely compressed, so that death will result from the concurrent effect of apoplexy and asphyxia. 3. If, on the other hand, the ligature be placed *between the os hyoides and the thyroid cartilage*, or *upon the os hyoides*, and rests upon the angles of the jaw or

the mastoid processes, the vessels will be almost entirely protected from compression, and the respiratory acts will alone be affected. Occlusion of the rima glottidis is produced by the depression of the epiglottis, which is forced down by the displacement of the mass of flesh that forms the root of the tongue. In this case death will be almost purely owing to asphyxia. 4. Lastly, if the cord be applied *over the trachea*, the passage of air will be completely checked, and asphyxia will soon result; the event will be less rapid if the ligature cross the cricoid cartilage. The vessels will, of course, be also compressed, when the cord is thus fixed; and the signs of apoplexy will be found more or less coexistent with those of asphyxia.

It is to be recollected, in making such distinctions, that congestion of the cephalic veins is an ordinary appearance in cases of simple asphyxia; so that it might seem unfair to consider it of an apoplectic character in any instance in which there is not actual extravasation. But the value assigned to it will depend upon its amount when compared with that of other portions of the venous system, and upon the comparative state of the right and left sides of the heart. If the pulmonary arteries, the right cavities of the heart, and the great veins leading to it be all gorged with dark blood, whilst the left cavities and their vessels are flaccid, it is evident that the congestion of the brain is only a part of the general result of the cessation of the respiratory function. But if, as sometimes happens, no such general congestion is found, and the right side of the heart is not peculiarly distended, whilst the veins and sinuses of the brain are loaded, we may regard the latter as an apoplectic condition not immediately dependent upon obstructed respiration, though aggravated by it if it co-exist. And here it is necessary to remark, that although in cases of apoplexy with gradually increasing coma, asphyxia seems to be generally the proximate cause of death, there are many instances in which the fatal result occurs too rapidly for it to be thus accounted for, and in which it seems rather due to a sudden violent impression transmitted through the nerves to every part of the system, destroying the vitality of the whole at once, and putting an immediate stop to the motion of the blood. It is this kind of impression which is produced by concussion of the brain, by blows on the epigastrium, by a violent electric shock, and other similar causes which check at the same time the action of the heart and that of the capillaries, producing death by syncope. It is well-known that in the lower animals the circulation will continue after the gradual removal of the whole of the brain and spinal cord; whilst sudden violent and extensive injuries of these centres, such as crushing the brain, or breaking down the spinal cord, entirely check it. This fact appears to indicate the actual propagation of an *anti-vital* influence (if we may be allowed the term) along the nerves in cases of this nature, since the mere suspension of the function of the nervous centres cannot prove similarly fatal. In this manner only can we account for the suddenness of death in the *apoplexia fulminans*; and the same view seems applicable to several cases of death by hanging, in which the appearances are very different from those of the more common forms of apoplexy or of asphyxia, as will presently be pointed out.

The obstruction to the passage of air through the air-tubes, and the pressure upon the bloodvessels of the neck, are not the only causes of death by suspension, although it is probable that they alone are in operation when the cord has been tightened simply by the weight of the body. When greater violence has been used, it is not unfrequently found that the vertebral column has been injured, so as to compress or lacerate the spinal cord. This injury may be of several kinds, but it is generally confined to the first and second cervical vertebræ. Sometimes the odontoid process has been displaced from the atlas, with rupture or laceration of the ligaments which confine it, and has been forced against the spinal cord. In other instances it has been separated from its own vertebra; and these displacements of the atlas upon the dentatus may happen in various ways. Again, the two first vertebræ have been separated from the rest of the column, by rupture of the intervertebral substance and, of

the spinal ligaments. Other fractures of these vertebræ have been seen; and in all, the spinal cord was more or less injured. But even where no evident displacement is found, there is often an appearance of straining of the ligaments; and in such cases the spinal cord must have received a severe shock, which will obviously aid the other causes of death, if not itself competent to produce it.

Anatomical characters. From what has been stated as to the operation of several causes, singly or combined, in producing death by strangulation, we shall be led to expect a considerable variety in the morbid appearances afterwards found; and, indeed, it is almost only from the observation and comparison of these appearances, that our knowledge of the action of these causes is derived, since the means of observing them during life are so restricted. The description given by the older writers of the signs of death by strangulation will only apply with strictness to a limited number of cases. Indeed it may almost be asserted, that some of the appearances mentioned are incompatible with each other, and that the description must have been drawn up by combining observations made upon several dissimilar cases. The following have been specified:—"Lividity and swelling of the face, especially of the lips, which appear distorted. The eyelids are swollen and of a bluish colour; the eyes red, projecting forwards, and sometimes forced out of the orbitar cavities; the tongue enlarged, livid, and compressed between the teeth, or frequently protruded. A sanguineous froth about the lips and nostrils. A deep and ecchymosed impression around the neck, indicating the course of the cord, the skin being sometimes excoriated; laceration of the muscles and ligaments in the hyoideal region; laceration or contusion of the larynx, or of the upper part of the trachea. There are also commonly circumscribed ecchymosed patches, varying in extent, about the upper part of the trunk, and the upper and lower extremities, with a deep livid discoloration of the hands. The fingers are generally much contracted or firmly clenched. The urine, the fæces, and the seminal fluid, are sometimes involuntarily expelled at the moment of death. The body is, *cæteris paribus*, a much longer time than usual in parting with its heat." (Taylor's *Medical Jurisprudence*, vol. i. p. 165.) Some of these signs may be observed on the bodies of most persons who have come by their deaths in the mode in question; but it must be also admitted that they may all be absent. This is especially the case where the general shock to the nervous system appears to have been the proximate cause of death. They are usually most developed where death has supervened slowly, and has been due either to asphyxia produced by the direct obstruction of the windpipe, or to gradually increasing coma resulting from the accumulation of blood by pressure on the vessels of the neck. In either of these cases we find the mode of death indicated internally by the general venous congestion, already described as indicative of asphyxia, with more or less peculiar turgidity of the vessels of the brain. It will be desirable to examine separately each of the principal external signs, with the view of determining the circumstances under which they should be respectively relied on, or their absence made a ground of hesitation.

The lividity of the face, lips, and eyelids, and the prominence and brilliancy of the eyes, are not unfrequently absent, at least for some time after death. It is somewhat remarkable that the appearance of the countenance is usually least altered in suicides; its traits being frequently those of undisturbed placidity. These signs are, on the contrary, more constantly observed on the bodies of those who have been executed; and they are still more developed where *strangulation*, as commonly understood, has been murderously performed. On an instance of this kind the graphic description given by Shakspeare was founded. (*Henry VI.* Pt. ii. Act 3. Scene 2.) It is frequently observed, however, that although the face presents no lividity, and the lips and eyelids no tumefaction, soon after the body has been cut down, these appearances present themselves after an interval of some hours, especially

if the ligature be allowed to remain about the neck. This was pointed out by M. Esquirol (*Arch. Gén. de Méd.* Jan. 1823), who was the first to draw attention to the uncertainty of these appearances in cases of hanging. Although, however, their absence cannot support a negative inference, their presence may be held as a proper foundation for a positive presumption; that is, if a body be found hanging, or with a ligature tightly drawn round the neck, and these signs are present, the presumption is very strong in favour of death having taken place by strangulation. For they cannot be produced by suspension *after death* from other causes, even if this be effected immediately upon the extinction of life. This has been established by the experiments of Orfila. Sometimes lividity and tumefaction of the face will appear after an interval of some hours, even when the ligature has been removed, as was the case in some of the instances mentioned by Esquirol; more recently this has been noticed by Fleischmann (*op. cit.*, p. 436.), who attributes it to the change of position of the body, causing the blood (remaining fluid as it does) to run towards the head, which is often in the removal the most depending part. In the case of the notorious Burke, it is stated by Mr. Watson (*Treatise on Homicide*, p. 136.), that by changing the position of the body after the cord had been removed, the congestion of the vessels of the head and face could be made to appear and disappear at pleasure. As a general fact it may be stated, that the more slowly death supervenes, whether from asphyxia or from apoplectic coma, the more decidedly will these signs be presented; and that, on the contrary, they are likely to be absent whenever death results from the sudden shock sustained by the nervous system, or from complete obstruction to the entrance of air into the lungs.

The protrusion of the tongue has been considered by most writers (after Belloc) as dependent upon the position of the ligature. If this press above the os hyoides, it is stated that the tongue will be drawn backwards into the mouth; but if below the cricoid cartilage, the laryngeal apparatus will be drawn upwards, and the tongue protruded. But it must be remembered, that this protrusion of the tongue may be found in the bodies of those who have died of asphyxia from other causes, or of other diseases. Moreover, M. Devergie states (*Traité de Méd. Légale*, tom. ii. p. 384.), that he has found the tongue protruded between the teeth, when the ligature has been applied even above the os hyoides; and that the same effect may be produced on the dead body: whilst he has occasionally found it within the mouth, when the ligature has been on the larynx or below it. According to Fleischmann, this change, like the former one, is mostly produced by the gradual approach of death; and is likely to be absent where death has been almost or altogether immediate. Further inquiry is certainly needed on this point; but in the mean time it may be safely stated, that, if a body were found with the tongue protruding between the teeth, and bearing their impressions, and other indications of strangulation were present, little hesitation need be felt in attributing death to this cause.

The next point to be considered is a very important one — the mark of the ligature upon the neck. A good deal of confusion will be found in the statements of medico-legal writers on this subject, arising principally from the vague and contradictory significations which have been attached to the term *ecchymosis*. By true ecchymosis is to be understood an infiltration of blood into the internal substance of the skin and subcutaneous cellular tissue, so that thin laminæ of these textures shall be found penetrated with it. This can only be substantiated by dissection; and from neglecting this mode of examination many observers have mistaken for ecchymosis the external discoloration which is often entirely independent of it. Thus we may account for the great diversity in the proportions given by different observers, of the instances in which ecchymosis was found on the neck after death by strangulation. Remer declares that nine tenths of his cases presented it; whilst Klein relates fifteen cases which came under his own observation, and Esquirol twelve under like

circumstances, in none of which was this lesion observed. Devergie has collected fifty-two cases in which the state of the neck was particularly observed, and in only three of these did true ecchymosis exist; and Dr. Casper (*loc. cit.*), states, that out of seventy-one cases, twenty-one were accompanied by true ecchymosis. Of the cases collected by Remer, many were probably furnished by persons who were unacquainted with the characters of true ecchymosis; and it is not surprising, therefore, that he should estimate the proportion so high. The discrepancy between the accounts of Klein, Esquirol, Devergie, and Casper, is however, at first sight, more striking. Still, it would probably be reconciled had we more precise information as to the mode of death in each class of cases; for it is observed that ecchymosis rarely or never occurs after suicidal hanging, where for the most part the body has not fallen violently upon the cord, whilst it is much more frequent on the necks of those who have been murdered or executed. The following curious case is related by Dr. Casper. A young man in a fit of drunkenness hung himself with a stout cord. He was cut down in about half an hour afterwards; and attempts were made at resuscitation. The cord had merely produced a slight superficial mark on the neck, destitute of any appearance of ecchymosis. Signs of returning animation began to manifest themselves; the efforts of the medical attendants were continued for several hours, but the traces of vital reaction disappeared. To the astonishment of all present, when life was about to become extinct, the mark on the neck became deeply ecchymosed; this was verified by an examination made the next day. This case is an illustration of the physiological fact, that to produce true ecchymosis there must be a continuance, for a certain time, of the vital processes to which it is due; and that, where death is very suddenly occasioned by violence of any description, all marks of that violence may be absent. This has been repeatedly observed in cases of death from concussion of the brain, blows on the epigastrium, &c. When ecchymosed spots are found on the neck, their correspondence with the indentation of the ligature should be carefully examined; since it not unfrequently happens that they result from violence previously inflicted, which the suspension has only been intended to conceal. Where a true ecchymosis is found in the line of the cord, little doubt can be entertained of the strangulation having taken place during life; since all experimental researches yet performed agree in a negative result as to the possibility of any true ecchymosis being produced by the application of a ligature after death, even although but a short time has elapsed. Experiments are yet wanting, however, as to the possibility of producing a true ecchymosis by suspension *immediately* after death; such a point is obviously very difficult of decision, and at the same time of the utmost consequence in a medico-legal view. In one instance related by Dr. Casper, the mark produced by the application of the ligature was so decided, that an individual not acquainted with the circumstances would have supposed from it that the deceased had been hanged while living. But the subject had died of typhus; and although the experiment was tried an hour after death, marks of cadaveric lividity had already shown themselves; so that the tissues must have been in a state peculiarly favourable to the production of this appearance. Still, however, there was no infiltration of blood in the skin or cellular texture.

The mark which is most constantly left on the neck after death by strangulation, is a line of slight brownish-yellow discoloration, along which the skin has the dryness and hardness of parchment. This is seldom absent where *a cord* has been applied; but where strangulation has been effected by a handkerchief or other soft material, the pressure may be diffused over so large a surface that even this may not be produced. The Thugs of Hindostan, who use their turbans for this purpose, are said to accomplish their work so dexterously, as to leave no external mark whatever of the mode in which they have destroyed life. Where an indentation has been produced by the ligature, its lips have a violet tinge, especially when the ligature has not been removed; and with this the paleness, which the skin of the depression presents on first

being exposed, strongly contrasts. It is not until after it has been for some little time subjected to the contact of air, that the discoloration and hardening of the skin are perceived. This character was first pointed out by M. Esquirol, who regarded it as indicative of strangulation during life; but from the experiments of M. Devergie and Dr. Casper it appears, that it is of little or no value as a single proof, since it may be produced by suspension after death. All that is required appears to be a sufficient force in the application of the ligature, and its subsequent removal. But the violet tinge of the lips of the depression cannot be so completely imitated by *post mortem* strangulation; and even though it may show itself on the upper side, it is scarcely perceptible on the lower. Whenever this is very decided therefore, and is presented by *both* lips of the furrow, it is a tolerably positive indication of strangulation during life. We must not expect to find such a mark, however, all around the neck. It will be most decided where there have been any resisting points beneath the ligature. In case of death by suspension, we should not expect to find it at any great distance from the larynx, or os hyoides. Where strangulation has been practised, however, the circle will be more complete; and by a careful examination, we may thus be enabled to pronounce that the subject has been strangled first, and then hung —a mode in which attempts have often been made to conceal the first crime, by exciting suspicion of suicide. Sometimes when the ligature has been hard (a piece of new cord, for example), and roughly applied, slight excoriations are produced by it, the epidermis and corpus mucosum being rubbed off. The degree of vascularity of the true skin at these spots will generally indicate whether or not the violence has been inflicted during life; and this may even be detected after the desiccation of the skin by holding it between the eye and the light. But it must be remembered that the same cause which prevents ecchymosis may prevent any vital reaction of this kind, so that a negative inference must not be drawn from its absence. Another change is produced by the forcible application of a ligature, to which also M. Esquirol was the first to direct attention. If the skin of the furrow be carefully dissected off, leaving all the cellular substance behind, a whitish silvery line will be perceived, marking its course along this tissue. This appearance seems to result from the condensation of the tissue, occasioned by the forcing of its fluid and fatty matter into the surrounding substance. If desiccation has proceeded far, the mark will not have a glistening, but a white and dry aspect. This also is principally observed on the front of the neck, and sometimes over the sterno-mastoid muscles.

A very important branch of this inquiry is that which relates to the possibility of an impression like that of a strangulating ligature being made during parturition, by the twisting of the umbilical cord round the neck of the child, and the traction to which it will be subject if not preternaturally long. Medical jurists and accoucheurs seem pretty fully agreed as to the improbability of such an occurrence; and most authors deny its possibility. Klein, for example, states, that although he has examined a considerable number of infants who came into the world with the cord twisted round the neck, he has never detected any traces of it, either in the form of actual ecchymosis or of any impression whatever. The importance of this question to the medical jurist is evident, from the frequency of attempts to conceal the commission of infanticide by strangulation, by twisting the cord around the neck, so that death may be referred to natural causes. This contrivance may often be detected by collateral evidence, although we may admit the possibility of an impression being produced on the neck in this manner; thus, foreign matters, such as bits of straw, fine gravel, &c. have been found on the inside of the folds of the cord; or the child has been proved to have breathed freely. That an impression *may be* thus produced however, and that the child may die from this kind of strangulation, and may still have breathed, is proved by the collection of cases recently published by M. Taufflieb. (*Annales d'Hygiène*, tom. xiv. p. 340.) In one of these the infant had lived for a quarter of an hour, and its lungs were cre-

pitating and floated in water; but it had evidently died of apoplexy, for which the twisting of the umbilical cord sufficiently accounted. In this case the mark was a narrow red line encircling the neck, without any extravasation or depression. In another there was a livid mark, and the skin had assumed the *parchment* character, which was sensible to the touch as well as to the sight. M. Carus relates a case in which *sugillation* resulted from the same cause; but whether true ecchymosis is to be thence understood, we are unable to say. It has been supposed that the margin of the os uteri might, in a case of protracted labour, occasion a similar impression by contracting on the neck; but we are not aware that any positive example of such an occurrence has ever been produced.

Additional marks of violence about the neck, such as rupture of the muscles in the hyoideal region, fracture of the os hyoides or of the cartilages of the larynx, are of rare occurrence. When such are found, they afford a strong indication that the strangulation has *not* been suicidal, since very few instances have been recorded in which any of these have resulted from self-inflicted violence. It may not be possible to say, however, that these injuries were inflicted during life, and that they are to be relied on as proving that death was due to the suspension or strangulation which produced them. For, if inflicted *immediately* after death from other causes, the appearance they present may very much resemble that which they would assume if they had been suffered at the termination of life, so that they do not forbid the idea of the subject having been murdered first, and suspended or strangled afterwards. Another indication of death by strangulation has been pointed out by M. Amussat, — namely, rupture of the inner and middle coats of the common carotid arteries. This, however, has been only twice noticed; once by M. Amussat, and once by M. Devergie. It is not improbable that it may not be of unfrequent occurrence, escaping observation from its peculiarity; but we have no evidence that it may not be produced by post mortem strangulation. The ecchymosed patches which have been described as common on the upper part of the body in persons who have been strangled, are seldom any thing more than spots of peculiarly deep lividity, which occur after all the varieties of death by asphyxia. Where decided ecchymosis is found, we should be led to attribute it to external violence. The contraction of the fingers cannot be much relied on; as, although pretty general in death by strangulation, it is almost equally common in other kinds of violent death.

The state of the genital organs has been much attended to, as a character of strangulation. Erection of the penis not unfrequently occurs, and it is often followed by emissio seminis. It is not very easy to say in what proportion of cases this takes place. Erection may occur at the moment of suspension, and may subside afterwards, so that no traces shall be found of its having taken place. In Dr. Casper's memoir already referred to, it is stated that this change took place at the moment of suspension in every one of fourteen negroes who were executed together; but that in only nine were any marks of it found an hour after death. M. Devergie has recently attempted to show, that where no appearance of erection is found, there is a general congestion of the vessels of the genital organs, which does not subside for some time, and which contrasts strongly with the usual pallor of these parts after most kinds of death. (*Annales d'Hygiène*, tom. xxi. p. 174.) The membrane of the urethra he has found highly injected, especially towards the extremity of the penis. No sufficient evidence has yet been brought, however, to prove that a corresponding state is generally produced in the genital organs of the female; it has been detected in a few instances by Remer and Casper. Emission of the seminal or prostatic fluids is more frequently perceived to have taken place; but it is liable to occur from other causes, such as injuries of the spinal cord by direct violence. Casper met with this emission in nineteen out of seventy-seven cases, — not much oftener, therefore, than one in four: but others have observed it more frequently. Care must of course be taken,

not to mistake it for a discharge from the urethra itself. Devergie has recently maintained (*loc. cit.*), that some effusion of semen into the urethral canal almost constantly takes place, although it may not be ejected from it; and he calls in the aid of the microscope to detect the animalcules characteristic of this fluid. He states that, soon after an ordinary emission during life, all traces of it disappear from the urethra; but that if it be soon followed by death, an appreciable quantity will remain there. This view is obviously deserving of considerable attention; and in no case of doubt should the test be overlooked. But there are several objections to exclusive reliance upon it, some of which have been acutely pointed out by M. Orfila (*op. cit.*, p. 471.), and we can only use it in conjunction with the facts supplied by other observations. Lastly, evacuation of the fæces is a comparatively rare occurrence; Casper observed it only four times in 106 cases.

With regard to the internal appearances, little need be added to what has been already stated. They will generally be those of asphyxia, together with a peculiar degree of congestion in the veins of the head. But this may be altogether absent, or it may be the only morbid appearance, in which case we should attribute death to apoplexy alone. In some cases no morbid appearance whatever can be detected. Extravasations of blood beneath the mucous membrane of the stomach and intestines are more common in this than in other kinds of asphyxia.

From the details we have thought it right to give on this difficult subject, it will be evident that no *single* signs can be regarded as sufficiently diagnostic of death from strangulation, for us to rely upon either their presence or absence in doubtful cases. Our decision must be founded upon the balance of several; and it will be rarely that a full investigation will leave much room for doubt. We shall, however, bring such a case under review, since it will serve to prove that death by hanging *may* take place, leaving scarcely any of the signs which have been usually regarded as characteristic of it. A man aged about thirty-six or forty years, robust and plethoric, was found hanging on a tree in a forest. He had employed for the purpose of suicide a narrow leather thong, and had disposed it in such a manner that anteriorly it pressed between the larynx and os hyoides, and then directed itself upwards and backwards. The furrow produced by it was a quarter of an inch deep in front, rather less on the left side, and almost imperceptible on the right, where there was a knot beneath the ear by which an impression was left. The furrow was somewhat rough to the touch, and its colour was a deep yellow. No ecchymosis was found in any part of its course, or in its neighbourhood. The countenance presented no appreciable change; it was calm and pale, without disfigurement. The appearance of the eyes was in all respects natural; there was no sanguineous injection; and their globes were not prominent. There was no protrusion or lividity of the tongue; the vessels of the brain, lungs, and superior extremities contained fluid blood, but they were by no means gorged; this blood preserved its fluidity for fourteen days after death; — a moderate quantity was found in the right ventricle; the left was nearly empty. The lungs were in a state of flaccidity very remarkable; they were so sunk in the thoracic cavity, that they did not even cover the heart laterally. (Orfila, *Traité de Méd. Lég.*, tom. ii. p. 409.)

The *treatment* of cases of strangulation is to be conducted on the general principles already stated, with such modifications as the peculiarity of the case may seem to require; bleeding to a small amount, especially from the jugular vein, is evidently indicated where there is much turgescence of the vessels of the head; but it should never be carried far at first, though it may be subsequently necessary to abstract a larger amount when the circulation is re-established. When the face is pale however, and the general appearances are not those of venous congestion, such a step is highly improper; and the administration of stimulants is rather indicated. It will be seldom that any measures can be successful after the lapse of a few minutes, unless

there be some peculiarity in the circumstances of the suspension. It has happened more than once that ossification of the larynx has prevented the occlusion of the air-passages, and that the position of the ligature has been such as not seriously to impede the circulation, so that recovery has taken place after a whole night's suspension.

Submersion. Although death cannot, in strictness, be said to take place by submersion, unless the whole body be covered by fluid, the distinction is of little practical importance; and the term may be conveniently applied to all those cases in which the entrance of air into the lungs is prevented by the immersion of the mouth and nostrils in water or other liquid. With our present knowledge of physiology, especially in regard to the vital importance of the function of respiration, it seems extraordinary that any difficulty should ever have been felt in accounting for the occurrence of death under such circumstances. So little, however, was the subject of asphyxia formerly understood, that the fatal termination was attributed to the injurious effect of the contact of water with the surface of the body. In order to show that an animal could live under water, provided that the continuance of its respiration were insured, M. Gauteron made the following experiment:—Having fixed a long tube into an opening in the trachea of a dog, he forcibly retained the animal at some depth under water, keeping the end of the tube above the surface. In this situation the animal remained upwards of a quarter of an hour, respiring freely through the tube; and at the termination of the experiment, it was found to have sustained no injury. This may almost be regarded as a useless cruelty, when it is remembered that a similar experiment has been prepared for us by Nature, who has adapted the elephant to remain for an almost indefinite time under water, by the prolongation of the air-tube through its extended proboscis. Various other hypotheses have been advanced to account for death by submersion, some of them almost equally absurd with that just mentioned. Of these it will be desirable to advert to a few, which are founded more or less upon observed facts.

Among the older writers we find death ascribed to the ingestion of water into the stomach—almost as unphilosophical a cause as it is possible to imagine. Many cases of drowning occur in which no water passes down the œsophagus; and its entrance appears to depend on certain accidental circumstances which will be explained hereafter. Even if it were constantly found, it would be ridiculous to attribute death to it; since it is well-known that a much larger quantity than is ever seen in the stomach of a drowned person may be ingested without any deleterious effect.

By many physiologists, the introduction of water into the air-passages has been conceived to be the proximate cause of death. With our present knowledge, however, it must at once be evident that this can only be injurious by preventing the entrance of air into the air-cells; and that it cannot, therefore, be more prejudicial than the external obstruction. Other fluids may be more deleterious; but water, if so introduced in the healthy state, is gradually absorbed. Goodwyn injected two ounces, by small quantities, into the trachea of a cat; the animal seemed to breathe with some difficulty, but did not seriously suffer, and was at last strangled. Similar experiments were tried by Gardanne and Vernier upon dogs and rabbits; they injected four times more than is ever found in the lungs of these animals when drowned; and they found that the dyspnœa gradually passed off, and that perfect recovery took place. It is quite possible, however, that when respiration is suspended, and before absorption can take place, the introduction of any considerable quantity of water into the lungs may contribute to stagnate the pulmonary circulation; since it has been found by Dr. Southwood Smith that, if water be injected into the air-passages so as completely to fill them, it is almost impossible to force any liquid through the pulmonary artery.

Others have ascribed death by drowning to a collapsed state of the lungs, by which it is supposed that an impediment is offered to the passage of blood

through them. Though it frequently happens that a large quantity of air is expelled during submersion, and that this being replaced by none, the lungs are found to contain little air after death, such is by no means invariably the case; and we cannot, therefore, attribute death to this cause. Even supposing it were constant, it would require to be proved that this collapse offers any sufficient impediment to the passage of blood, which we have no reason whatever for believing. That it aids in producing the stagnation when it does take place, may, however, be reasonably admitted; since it is known that a much-contracted state of the lungs is as unfavourable as over-distension to free circulation through them.

Congestion of the cerebral vessels, also, has been alleged by some to be the proximate cause of death by drowning. It is quite true that this state is found to exist after death in a large proportion of those who have thus perished; but it by no means follows that it is the immediate cause of the fatal result. We have already seen that it is one of the usual phenomena of asphyxia, and that it is a consequence of that stagnation of blood in the lungs which operates so injuriously on the vital functions in general; whilst, on the other hand, this congestion, supposing it to arise from some different cause, could only occasion death by itself producing asphyxia. The supposition is therefore untenable as a general explanation; although, as we shall presently see, it is applicable to particular cases.

We can have no hesitation in regarding asphyxia, occasioned by the obstruction to the admission of air into the lungs, as the principal cause of death in the greater number of instances in which it is produced by submersion. Still, as in the case of death by suspension, there are several collateral causes, the operation of which must be borne in mind, both as explaining the variations that we meet with in the *post mortem* appearances, and as having an important bearing on the medico-legal inquiries which are often founded on such occurrences. It is to Macquer that we are indebted for the first approach to a true view of this subject. He ascribed death by drowning to the deleterious alteration which the air contained in the lungs undergoes when not renewed by the actions of respiration. That such an alteration takes place was proved by the experiments of Berger, who states that the air expelled from the lungs of a drowning animal will be found to have lost fifteen or sixteen per cent. of its oxygen, having thus acquired about the same degree of contamination as an atmosphere in which respiration is carried on until asphyxia is induced. Although Macquer was evidently right in the main, his theory stops short at the important question, how the non-renewal of the air affects the movement of the blood, and the other vital functions. Having already discussed this question in full, as part of the general subject of asphyxia, we need not here return to it.

Death by submersion may be regarded as taking place in one of four modes. *First*, We shall suppose that an individual in the full possession of his intellectual faculties falls into deep water; he descends to a depth proportional to the height from which he fell, and then rises to the surface in consequence of his specific lightness, assisted by the buoyancy of the air which is entangled in his clothes. If he knows how to swim, he may keep himself there, until, his muscular power being weakened, he is incapable of the exertion; and he is then similarly circumstanced with one who cannot thus sustain himself. Although, if compared in ordinary situations, the human body is, bulk for bulk, considerably lighter than water, the case is altered when it is thus immersed in the fluid. The sudden shock, affecting the whole surface, occasions a general contraction of all the parts susceptible of it, but more especially produces a diminution in the bulk of the trunk. Of this any one may satisfy himself in the cold bath. Even when unaffected by mental emotion, he will find it almost impossible to take in a full inspiration; for the contraction of the abdominal muscles prevents the descent of the diaphragm; and the effect is increased by the pressure of the circumambient fluid, so that the abdomen

becomes almost flattened. There is no doubt that this alteration is increased by the influence of agitation and terror; and this is exercised principally on the first respiratory movements which take place when the individual rises to the surface. A part of the air which the lungs contained is expelled; and it commonly happens, that the attempt to replace it by inspiration causes the introduction of water along with air into the trachea. The former excites the tendency to cough; and in this effort a still larger proportion of the air is expelled, and the bulk of the chest is thus diminished. In the irregular struggles which follow the individual sometimes sinks, sometimes rises to the surface; and every time that his face meets the air an inspiratory movement is attempted, usually with the same consequences as at first, so that the air at first contained in the lungs is gradually diminished in quantity, and partly replaced by water. At the same time the fluid is generally introduced by these efforts into the stomach. During this period the usual phenomena of asphyxia are being developed. The circulation through the lungs is gradually checked, and a state of general venous congestion is induced. This will more particularly affect the internal organs in consequence of the influence of cold upon the external surface; and the functions of the brain will be speedily suspended under the combined influence of this cause and of the diminished supply of arterial blood. All movement then ceases; the asphyxia becomes complete; and the body sinks to the bottom of the water. Some bubbles of air are usually then expelled by the external pressure, which is no longer resisted by muscular effort.

Secondly, A state of syncope may supervene at the moment of immersion, by the influence of various causes, — such as the violent shock to the nervous system occasioned by the contact of cold water with the whole surface, or the sympathy of the corporeal structure with the agitation of the mind. In such cases the individual generally rises once to the surface, and then sinks without farther struggle. Some physiologists are disposed to consider this mode of death as hypothetical merely, and are not willing to appeal to it in elucidation of the remarkable facts already adverted to respecting the length of time during which submersion may be occasionally borne; but we cannot but consider their incredulity as the result of a want of fair consideration of known facts. In the first place there can be no doubt, from the accounts of various persons who have recovered, that syncope not unfrequently comes on at the moment of immersion; and the same inference may be drawn from the occasional absence of any signs of asphyxia or cerebral congestion, joined with the want of those indications of grasping movements, which we expect to find on the hands of those who have been drowned within reach of any objects that can be laid hold of. That we cannot produce it, in the same manner at least, by experiments on animals, is not to be wondered at; since they are not susceptible of the influences upon the nervous system just described. But the same condition may be induced by blows on the head; and an animal suffering from concussion is in precisely the same state, as far as its organic functions are concerned, with a human being in a state of profound syncope from mental emotion. Now it is found, that an animal in this condition may be submersed for a much longer time than one in a state of vital activity, without its ultimate recovery being prevented; and this is readily accounted for when it is remembered, that the circulating system is here primarily affected, and the functions of the nervous system already almost suspended, so that the small amount of aëration afforded by the air contained in the lungs is sufficient for the maintenance of life. This may be illustrated by the case of the hybernating animal already alluded to, which may be regarded as almost in a state of syncope; its circulation being very feeble, and its respiratory movements scarcely perceptible. It may be said to *live more slowly* than when in a state of activity; and just in proportion to the slowness of its life, is its power of supporting the deprivation of air The same may be said of the whole class of reptiles when compared with that of birds. There is no phy-

siological difficulty, then, in accounting for the preservation of vitality by a human being after an immersion of half an hour, or even of three quarters; and that this occasionally takes place there is evidence which we have no right to doubt. Mr. Taylor however, in his recent excellent work on medical jurisprudence, withholds his assent, on the ground that we have no proof, in any of these cases, of the individual not having occasionally respired at the surface, during the time when he was supposed to be submersed. He has overlooked, however, the following case, which, though involving a shorter duration, is one which establishes the condition of *syncopal asphyxia* beyond a doubt: it is related by Marc (*Manuel d'Autopsie Cadavérique Médico-Legale*, p. 165.) on the authority of Plater. A woman convicted of infanticide was condemned to be drowned. This punishment was inflicted in Germany by the now obsolete Caroline Law, according to which the criminal was inclosed in a sack with a cock and a cat, and sunk to the bottom of the water. In this instance the woman, after being submerged for a quarter of an hour, was drawn up, and spontaneously recovered her senses. She stated that she had become insensible at the moment of immersion. This form of death will be most common among persons of susceptible nervous system; and therefore more frequent in the female than the male sex.

Thirdly, A state of syncope may supervene, under the influence of mental emotion, when the individual has been immersed for some little time, and death may thus result in part from asphyxia and in part from syncope.

Fourthly, Death may result from some primary disturbance in the functions of the brain, produced by the direct operation of external causes. Thus, a person falling into the water in a state of drunkenness, or in the midst of a violent struggle, will have already become the subject of congestion of the brain, which, when aggravated by external cold and pressure, and by the impediment soon offered to the pulmonary circulation, may be regarded as the proximate cause of death. This is still more decidedly the case when the head strikes some hard substance in its fall, of which an apoplectic effusion is the consequence; and we then find no signs of asphyxia referrible to the submersion. As already stated, however, it is most common to find marks of cerebral congestion accompanied by the appearances which ordinarily indicate asphyxia.

We shall now consider in some detail the *anatomical characters* usually regarded as characteristic of death by drowning, the circumstances under which they are respectively produced, and the degree of importance to be attached to each.

1. In cases where death has resulted from simple asphyxia, a livid tint may sometimes be observed in the face, though this is frequently pale; discolorations are more commonly found on the hands and feet, and on other parts of the body. The appearance of the surface, however, will greatly depend upon the duration of the immersion, and upon the length of time during which the body has been subsequently exposed to the air; this will be detailed subsequently as being common to all the modes of death above described. The eyes are generally half open, and the pupils dilated. The mouth and nostrils are covered with a mucous froth; the tongue pushed forwards against the incisor teeth, but not usually protruding externally. A mucous froth, rarely sanguinolent, covers the lining membrane of the larynx, trachea, and bronchi; the membrane itself is sometimes deepened in colour. Water is occasionally found in the air-passages. Sometimes it exists only in the trachea and the primary divisions of the bronchi, not exceeding half a spoonful in quantity; whilst in other instances it fills the air-tubes to their ultimate ramifications. Any substances suspended in it, such as mud or vegetable matter, may afford important indications of the locality at which the submersion took place. The lungs are usually gorged with dark fluid blood, and are sometimes so distended as to meet when the anterior mediastinum is cut through. The circulating system presents the condition described as produced by asphyxia. The sto-

mach often contains water. Sometimes a small quantity of dark or even bloody urine is found in the bladder.

2. When syncope has been the cause of death, on the other hand, extremely little alteration from its natural condition is found in any part of the body. The whole surface is pale. The trachea sometimes contains a little water, but no froth; the lungs are sometimes collapsed, and never preternaturally distended.

3. In the third class of cases above described, the signs mentioned as characteristic of the first are observable, but in a less decided form. The right cavities of the heart, and the vessels connected with them, are fuller than those on the left side; but the latter are not entirely empty. The lungs are moderately distended with blood; but little froth exists in the trachea, and little or no water. Fluid is often found to have entered the stomach. These are, perhaps, the most common appearances, it being rare to find cases in which all those first described present themselves.

4. Death from an unequivocally apoplectic condition is extremely rare in cases of drowning: it will of course be recognised by the appearances characteristic of that state: it not unfrequently happens, however, that the congestion of the cerebral vessels is greater than that which would simply result from asphyxia.

We shall now inquire into the value of the chief of these signs, considered separately, as indications of death by drowning.

The aspect of the surface depends much upon the length of time during which the body has been immersed, and upon the interval which elapses between its removal from the water and the inspection of it. If it have remained in the water only a few hours after death, and be examined soon after its removal, but little discoloration will commonly be found, unless the phenomena of asphyxia have been developed to an extraordinary degree. A body which has been immersed in water, however, undergoes very rapid decomposition when removed from it; and the longer the immersion, the more rapid the decomposition. A very few hours will thus effect such a change in the aspect of a body which has been some weeks immersed, that it would scarcely be recognised again. This change takes place the most rapidly in a high temperature; so that a body which has been withdrawn from the water, with scarcely any discoloration of the skin or tumefaction of the face, will in summer very soon appear livid and bloated, and the features extremely distorted. The discoloration takes place most rapidly in the parts most freely exposed to the contact of air; and it is not observed on cutaneous surfaces which have been in close opposition with each other, or with their coverings. The skin becomes at first of a livid brown colour, which gradually passes into a deep green. According to Orfila, the progress of this change enables us to distinguish it from that occasioned by decomposition under other circumstances. In general, the first part of the trunk which is so affected, is the skin of the abdomen; but in submerged bodies, it is the integuments of the thorax. Discoloration of the surface will take place, however, without exposure to air, provided the immersion have been sufficiently protracted; but as it is not confined to bodies that have suffered death by drowning, this is not the place to enter into a description of these changes, which have been minutely detailed by M. Devergie (*Ann. d'Hygiène*, tom. ii. 5.; and *Méd. Lég.*, tom. ii.), whose opportunities of observation are very great. It is right to state, however, that the accuracy of his descriptions is disputed by M. Orfila. (*Ann. d'Hygiène*, tom. vi.; and *Exhumations Juridiques*, tom. ii.)

An external sign which was formerly much relied on, is the presence of excoriations on the fingers, and of sand or dirt under the nails. This may obviously be of great importance in a juridical investigation; but as our present view of the subject is simply pathological, we may pass it over with a slight notice. It can only occur in those cases in which there has been a long struggle for life; and its absence, therefore, is no proof that drowning has not

been the cause of death in either of three out of the four modes above specified. Moreover, the local conditions of the spot where the drowning has occurred, may prevent any such marks from being formed. Where they are discovered, however, they may afford very important evidence as to the fact of submersion having been the cause of death.

The presence of mucous froth in the mouth and around its orifices, is an indication into the value of which it is right that we should carefully inquire. This froth is formed in the air-passages, and resembles a lather of soap; its appearance externally can only result from one of two causes; — either it has been formed in such quantity as to fill the bronchial tubes, the trachea, and the mouth, and then to escape from its cavity; or, having been produced to a less amount, it has been forced outwards by the extrication of gas in the lungs, which results from putrefaction. This change takes place most rapidly in summer; and hence it is far more common to find the mouth filled with froth, and the air-passages free from it, at this season than in winter, when it rarely occurs. As its formation takes place originally in the air-passages, we may regard it as occurring under the same conditions with the mucous froth in the trachea, — a sign of considerable value, although several medical jurists have denied that any weight can be attached to it. The experiments of Orfila and Piorry, confirmed by those of Mr. Taylor, have now satisfactorily established that mucous froth can only be formed in the air-passages when the animal rises frequently to the surface to respire. It appears to be produced by the agitation or admixture of the air so taken in, with the secretion from the lining of the air-passages, and probably also with a small quantity of water. If the animal is kept altogether under water until respiration have ceased, the trachea is found perfectly smooth. It must be remembered, however, that this froth may be formed in the trachea of those who die by other forms of asphyxia, especially when protracted dyspnœa has caused a great increase in the amount of fluid poured into the air-passages. It has been attributed in some instances to putrefaction; but this is evidently erroneous, since, as already stated, when gas is so disengaged in the lungs, it drives the froth upwards into the mouth. Little fallacy, then, will be found to exist practically, in regarding the presence of froth in the air-passages of a body taken out of the water as an indication that death has taken place by drowning; but, on the other hand, its absence cannot be relied on in proof of the contrary. We have seen that, in a considerable proportion of cases, it will not be formed at all; and even when it has been formed, it may disappear under the following circumstances: — 1. If the body remains long under water after death, so that the fluid obtains free admission into the trachea, the froth will disappear; this, it will presently be seen, is no uncommon occurrence. 2. If the body be exposed to the air for some days after its removal from the water, the froth will then commonly disappear. 3. If the body be placed with the head in a depending position after its removal from the water, and there be much fluid in the lungs, the draining away of this will wash the froth from the mouth and air-passages. These circumstances have been particularly dwelt upon by Orfila; and they must be carefully borne in mind when the sign in question is absent in a case of supposed drowning.

Connected with the appearance just discussed is another to which considerable importance has been attached in juridical inquiries — the presence of water in the air-tubes. It is strange that this occurrence should have been denied by so many observers, since it is so easily substantiated by experiment. It has been almost invariably found to take place by Orfila, when animals were submersed; and as he used coloured fluids, of which very small quantities could be detected and distinguished from the serous fluid sometimes excreted into the passages, there is no room to doubt, that some amount of the surrounding liquid enters the trachea in ordinary cases of drowning. The quantity, however, is extremely variable. It probably depends in part upon the number of forced efforts at expiration made by the animal; but it does not, according

to Mr. Taylor, seem connected with the inspiratory efforts. This author states, that he has found it greater in the lungs of those which had been suddenly sunk to a great depth and drowned, than in other cases. (Taylor's *Medical Jurisprudence*, p. 128.) It has been maintained by some (and amongst them, Dr. E. J. Coxe of Philadelphia), that the water does not enter until the period of the final respiratory efforts, when the irritability of the glottis is supposed to be so far diminished that it does not resist its passage. But this has been disproved by Orfila, who performed the following experiment with a view to ascertain the truth. Having plunged two dogs under water, he secured the tracheæ by ligatures, after the submersion of a minute in one case, and of half a minute in another, the whole of the steps of the operation having been previously prepared. In both of these cases, he found liquid in the bronchial ramifications. After being so introduced, however, it may disappear under the same circumstances as those enumerated in the last paragraph. Still it would be sufficiently easy to make allowance for these, so as to render this sign almost pathognomonic, were it not that it may be imitated by the spontaneous entrance of water into the air-passages after death, when the body has remained long immersed. The possibility of this has been denied by many authors, who supposed that the valvular action of the epiglottis would be sufficient to prevent it. Experiment has fully proved it, however, not only in the case of drowned bodies, but where death has taken place from other causes, and the body has been subsequently placed in water. Orfila and Piorry found that the quantity thus admitted depended upon the position of the dead body. If it were retained under water with the head erect, the liquid penetrated freely to the ultimate ramifications of the bronchi; but it entered less freely when the body was in a horizontal position, and probably none would enter if the head were entirely depending. It is evident, then, that little importance can be attached to this sign when taken singly, though it may be useful if viewed in connection with others. The correspondence in character between the fluid in the lungs and that of the spot where submersion is supposed to have first taken place, and its difference from that in which it is found, may, in some particular cases, afford important evidence.

Another sign of corresponding nature, on which, perhaps, somewhat more reliance can be placed, is the presence of water in the stomach. Here, again, a remarkable discrepancy has existed in the opinions of different writers; some maintaining that it never enters during the act of drowning, and others, that it cannot penetrate after death. The truth, as on most disputed questions, appears to lie between the two extremes. The experiments of Goodwyn, Orfila, Taylor, and others, have fully proved that a quantity may be swallowed during the struggles of a drowning animal; and Mr. Taylor has shown that the amount is usually the greatest when life is prolonged by occasional respiration at the surface, whilst it is generally absent altogether when the animal has been kept beneath the fluid from the first. We must not, therefore, rely upon the fact of no water being found in the stomach, as disproving the supposition of death having been produced by drowning. It will probably enter but in small quantity, or not at all, in the three latter classes of instances formerly enumerated; and even when it has been introduced, it may disappear by the effect of position during removal, or by transudation through the body, if it be long exposed to the air, especially when much decomposed. On the other hand, its presence must not be relied on as a proof that drowning has taken place, since there is no doubt that water may enter the stomach of a body which has been submerged after death. It is true that the parietes of the œsophagus are usually so closely applied to each other, that water cannot enter without difficulty. The circumstances which seem to favour its admission, are advanced putrefaction, and the subjection of the body to considerable pressure whilst under water. To the latter condition attention has been particularly directed by Mr. Taylor, who found that if an animal be sunk to a considerable depth, the stomach becomes distended with water, even

though it be not allowed to respire; and as no deglutition can take place under such circumstances, it is evident that the water must have been forced in by its own columnar pressure, and that the same cause would operate still more effectually on a dead body, where no resistance is offered by the will. It is evident, then, that great caution must be used in drawing inferences from this sign when present; but it is perhaps, on the whole, the most valuable of all those which may be denominated the *accidental* signs of death by drowning, as it can only be produced after death under very peculiar conditions.

The alteration in the character of the urine is a phenomenon of rare occurrence, and no decided inferences can be drawn either from it or from the state of the bladder. To this last source Piorry was disposed to look, from observing that dogs usually empty that sac at the moment of violent death, and that it seems to be refilled by absorption from without, previously to the supervention of cadaveric rigidity; this, however, is not the case in man.

Little reliance can be placed upon the fluidity or coagulation of the blood, for very obvious reasons. The fluid state, supposing it to exist, may result from many causes besides drowning; and coagulation certainly takes place in the blood of a considerable proportion of drowned persons, being more common in the cavities than in the vessels.

With regard to the general value of these signs, therefore, in the determination of a case of suspected drowning, the same must be said as in regard to death by hanging—that our inferences must be founded upon the presence or absence of several conjointly, and not upon any single one. As a useful illustration of the preceding statements, we shall subjoin the summary given by Dr. Ogston (*Edin. Med. and Surg. Journ.*, vol. xlvii.) of the appearances presented in *seventeen* cases of drowning, mostly accidental, which occurred at Aberdeen. The only phenomena which were all but universal in these cases, were the dilated pupils, clenched jaws, and semi-contracted fingers. This state of the pupil was common to all the cases. In one only was the mouth open; in the rest it was firmly fixed both before and after the occurrence of rigidity in other parts. In every instance but one, the position of the fingers indicated the convulsive closure of the hands during the last struggle. The peculiar position of the tongue was almost invariably noticed, its tip being found in contact with the incisor teeth; in two cases only was it included between the closed jaws. In six of the cases, seen within six and a half hours after death, the surface was pale when first examined, and the countenance presented an appearance of extreme placidity; but discoloration and turgescence of the face speedily took place, especially when the weather was warm. The face was almost invariably reddened when the immersion had continued eight hours in warm weather; and swelling appeared soon afterwards. In three cases the *cutis anserina* was observed; two of these occurred in winter. In no instance were abrasions seen on the fingers, or dirt under the nails; this may be in part due to the local circumstances. In seven cases froth was found about the lips or nostrils. Out of the whole number only *seven* were examined internally. Of these, three presented the mucous froth in the trachea; in two, nearly an ounce of water was found in the trachea; and in two others, a considerable quantity escaped when artificial respiration was being practised. In five out of the seven cases examined, water was found in the stomach; and in several others its presence was detected by pressing the abdomen or turning over the body. In five of these seven cases, the blood was found partially coagulated in the heart, though fluid in the vessels. Besides the usual appearances in the thoracic portion of the circulating apparatus, a good deal of venous congestion was found in the head and abdomen in most of the cases examined.

Treatment. Little need be added, under this head, to what has already been stated in regard to the treatment of asphyxia in general. The point which will require peculiar attention in the resuscitation of drowned persons,

is the advantageous application of heat. Owing to the conducting power of water, a body which has undergone asphyxia by submersion will have lost much more heat in the same time than one which has been hung or strangled. Although the warm bath would appear the most advantageous means of restoring this, it is objectionable in the present case, since it prevents the due influence of the air upon the skin, which is important in two ways;—by promoting the movement of blood in the cutaneous vessels through its direct aërating powers, and by serving as an excitor through the nervous system, to the inspiratory actions. We fully agree then with Dr. Kay, in thinking that, in the treatment of asphyxia by submersion, warm dry air is the best medium to which the body can be exposed. Hot vessels of water, bricks, &c. may be applied to the spine and to the extremities, but not to the abdomen. Friction with warm flannels may be advantageously practised on the trunk; but nothing should interfere with the free contact of air to a large portion of the surface. Bleeding should be employed with great caution; but where the habit is plethoric, and the veins of the neck are turgid, they may be advantageously unloaded. In default of any other means of practising artificial respiration, the bandage of Leroy, or some substitute for it, may be employed. This is simply a large eighteen-tail bandage, formed by tearing a piece of linen into strips about three inches broad, but connected together by an untorn portion at the centre of each. This untorn portion being laid under the spine, and the strips being crossed over the thorax, compression may be very advantageously applied, so as to produce a partial expulsion of the contents of the lungs, which will be replaced by the elasticity of the parietes when the compression is renewed. This alternate pressure and relaxation should be kept up about twenty-five times in the minute; and if no large piece of cloth be at hand, it may be effected almost as well by a few handkerchiefs applied in a similar manner.

The great principle to be kept in view in the treatment of cases of drowning is, that the attempts at resuscitation should not be intermitted for several hours, nor even then unless there appear no chance of success. Many have been restored contrary to all expectation, when the treatment was continued simply in conformity with this principle. The patient should be watched for some time after his apparent recovery, as dangerous reaction sometimes comes on.

There is nothing in the characters or treatment of asphyxia by *suffocation*, or more properly *smothering*, that requires peculiar notice here; nor in those of asphyxia produced by simply *irrespirable gases*. As formerly stated, death from carbonic acid and other *noxious* gases more properly falls under the head Poisoning.

DISEASES OF THE ORGANS OF CIRCULATION.

DISEASES OF THE HEART.

Preliminary observations.— Anatomy of the heart — its site. — Relation of the lungs to the heart. — Structure.— Weight and measurement. — Motions. — Natural sounds.— Morbid sounds. — Disordered motions.—Arterial and venous pulse.—General observations on diseases of the heart.— Importance of accurate discrimination. — Means of diagnosis by local or physical signs and by general symptoms.— Causes.—Prognosis.— General view of their treatment.

Of the diseases to which the human frame is liable, few have of late years attracted more attention, or been investigated with greater ingenuity and perseverance, or with more successful results, than affections of the heart. It was impossible that a class of disorders characterised by symptoms of so prominent and distressing a nature should have altogether escaped the notice of the ancients; and accordingly traces of an acquaintance with them are to be met with in the writings of the Greek and Arabian schools, but generally so faint and indeterminate, in consequence of the prevailing neglect of pathological anatomy, that they are now little referred to except as matter of curiosity.

The foundation of the more accurate notions which we at present possess on this subject was laid by Harvey by his discovery of the circulation; and for the first solid and conspicuous portions of the superstructure we are indebted more particularly to Lancisi, the second Albertini and Valsalva, and their distinguished pupil Morgagni, and to Senac. Corvisart's graphic treatise on diseases of the heart, of which the first edition appeared in 1806, formed a new era in respect to the knowledge of these affections, and gave a fresh impulse to their investigation in various parts of Europe, as was speedily evinced by the successive appearance of the valuable works of Burns and Testa, Kreysig and Bertin. By the revival of Auenbrugger's method of percussion, and by Laennec's invaluable discovery of the stethoscope, new and unprecedented facilities were furnished for their study; and that these have not been neglected we have ample evidence in the pages of the great pathologist last named, as well as in the contributions of a host of able successors in the same path, more especially in this country and in France.

Anatomy of the Heart.

Before entering in detail upon the particular diseases to which the heart is liable, it may be useful briefly to recall to the reader's memory a few points of practical importance in respect to the site and structure of the organ, its normal size and weight, its component tissues, its motions, and the sounds by which they are accompanied.

Site of the Heart.

An accurate acquaintance with the position of the heart within the chest in its natural condition, the space which it ordinarily occupies, and its relation to the lungs and solid parietes of the thorax, as well as to the diaphragm, is indispensable to enable us to detect the existence of various degrees of displacement and enlargement of the organ, as well as the effusion of fluid which occasionally takes place into the sac, which in the healthy state closely embraces it. The heart, which is of an irregular conical form, flattened on the under

surface, is situated in the anterior mediastinum, towards the left side of the chest, behind the lower half of the sternum, the third intercostal space, and the cartilages of the fourth and fifth and sixth ribs.* Its base is directed upwards, backwards, and to the right side, looking towards the fifth, sixth, and seventh dorsal vertebræ, the œsophagus and descending aorta intervening; and its point consequently downwards, forwards, and to the left, answering, in the erect posture, and when the chest is in a medium state of distension, and the heart in the act of systole, to the fifth intercostal space, that is, in a middle-sized individual, to a point about two inches below, and one to the inside of the nipple; or two and a half from the outside of the base of the xiphoid cartilage. It is protected, and to a certain degree confined to its position by the sero-fibrous sac of the pericardium, which is strongly attached below to the diaphragm around its tendinous centre, and made fast superiorly to the great vessels some way above their origin, or about as high as the second rib; whilst they are in their turn fixed, in a manner, by their branches, and by connecting cellular membrane to the upper part of the thorax and root of the neck.

The pericardium and heart are covered laterally by the lungs, and also anteriorly, with the exception of a lozenge-shaped space of somewhat less than two inches across, answering to nearly the whole front of the right ventricle, and to the most anterior portion of the appendix of the corresponding auricle, together with merely the apex and external edge of the left ventricle. These exposed portions as well as the root of the pulmonary artery and the ascending aorta, after it has emerged from behind it, are separated from the parietes of the chest only by the pericardium and loose cellular tissue. About one third of the heart, consisting principally of the right auricle and the upper and right side of the base of the corresponding ventricle, lies behind the sternum. The orifice of the pulmonary artery and its valves, and consequently those of the aorta likewise, which lie posteriorly, but nearly in the same line, are placed immediately behind the upper edge of the fourth sterno-costal articulation of the left side.†

The auriculo-ventricular orifices of the two sides of the heart lie to the right and left respectively of the point just indicated, that of the right side being at a lower level by several lines. Where they approach each other most nearly, being scarcely the third of an inch apart, they would be actually covered by the root of the pulmonary artery, but that they are placed a little lower or nearer the apex of the heart. Still a moderate-sized stethoscope, applied over the origin of the pulmonary artery and its valves, will cover also the aortic orifice and its valves, as well as a very considerable portion, nearly a half of each of the auriculo-ventricular openings, a fact to which we shall afterwards have occasion to recur, on account of its practical bearing in the diagnosis of the different species of valvular disease.

The bulging portion of the pulmonary artery, just below the division into its two trunks, has been singled out by Dr. Hope as a fixed point of easy determination; being seated, as he states, between the second and third ribs of the left side, close to the sternum. The aorta inclines "slightly to the right as it ascends, coming in contact with the sternum where it emerges from beneath the pulmonary artery, following, or perhaps slightly exceeding, the mesial line till it forms its arch; the pulmonary artery, which is from the first in contact with the sternum, inclining more considerably to the left until it arrives at the interspace between the second and third rib."

A sharp instrument passed through the upper part of the sternum in the median line and on a level with the first intercostal space, would glance along the upper part of the arch of the aorta, as it is passing from the right side of the sternum to the left side of the third dorsal vertebra.

The antero-superior surface of the heart, which, as we have seen, is formed

* As in fat persons there is often much difficulty in counting the ribs, we may recall to the reader's memory that the nipple generally answers to the fourth rib.

† If examined from the back, they are opposite to a point just above the left side of the fifth dorsal vertebra.

chiefly by the right ventricle, is convex; whilst the postero-inferior surface, answering to the left ventricle, is flat, and lies upon the tendinous portion of the diaphragm, the motions of which it must necessarily follow. These, however, are obviously very limited, in consequence of the strong unyielding texture of the pericardium, and of the firm manner in which it is attached, as already mentioned, both above and below. Yet the heart is certainly carried a little downwards and backwards in inspiration, its apparent change of place being still farther increased by the sternum and anterior portion of the ribs simultaneously ascending; whilst in expiration, on the contrary, it rises again and moves a little forwards, the ribs at the same moment descending, and thus conspiring to magnify the apparent elevation of the heart. Hence a deep inspiration, as is remarked by Dr. Williams in his valuable lectures, makes the apex beat below the sixth rib. "The impulse is then, however, scarcely perceptible, because the chest expands as the ribs rise, leaving the heart and drawing the porous lung in front of it. A forced expiration, on the other hand, depresses the ribs, and transfers the strongest pulsation to between the fourth and fifth ribs, and by bringing down the walls into contact with more of the heart, makes its impulse perceptible over an extended space, as high as the third rib, and on the lower half of the sternum;" and a knowledge of these circumstances, he adds, enables us to test the freedom of the heart and pericardium, and the anterior portion of the lungs, from adhesions. Where the chest is narrow or deformed, or contracted from the chronic consequences of pleurisy, the impulse of the heart may be perceptible over a much greater surface than natural. "So also circumstances displacing the heart, such as tumours and effusions of liquid or air into the pleura, may greatly change the character and degree of the impulse, diminishing or increasing it, according to whether the displacement of the organ is from or towards the walls of the chest. Abdominal tumours, and even a distended stomach, may have to a certain degree the same effect." Changes in the pulmonary tissue are very influential in the same way; emphysema may intercept or circumscribe the impulse, whilst consolidation will propagate it over a larger space.

That the position of the heart is affected in a very sensible degree by gravitation, and consequently by posture, any one may satisfy himself by applying his hand over the spot where the beat of the heart is usually perceptible, and then turning the body successively on the back, the sides, and the face; when the organ will be felt to incline towards the most dependent part, retreating in the supine posture, and coming forward in the prone. The pulsation will be felt most strongly and over the largest surface when lying on the face and slightly turned towards the left; or, if we be sitting or standing, by inclining the body forwards and to the same side, and at the same moment making a forcible expiration. The change of the place of pulsation thus effected is however too inconsiderable to be confounded by any competent observer with the derangements of this kind dependent on original malposition of the organ, or on disease.

Relation of the Lungs to the Heart.

The extent of the uncovered portion of the heart may be ascertained, even during life, by the dull sound elicited by percussion from the corresponding portion of the chest. This in healthy well-formed individuals rarely exceeds, as we have seen, an area of about two inches in diameter, reaching from the point where the beat of the heart is felt to the left side of the lower half of the sternum. And hence arises a valuable source of diagnosis in disease; for in cases of effusion into the pericardium, or of organic enlargement of the heart, and perhaps also of its temporary passive distension by the excessive accumulation of blood within its cavities, the extent of this dulness will ordinarily undergo a proportional increase. Yet this, though a very valuable sign, is not to be considered, when alone, as affording unquestionable evidence of cardiac affection; for the interposition of a portion of hepatised lung, or of a tumour,

between the pericardium and the front of the chest, or a partial pleuritic effusion confined by false membranes, or even a great enlargement of the left lobe of the liver, would give rise to the same physical phenomenon. Nor, on the other hand, is the absence of such preternatural dulness decisive as to the non-existence of the cardiac lesions alluded to above; as an emphysematous state of the lung, or the presence of pneumothorax, or an unusual degree of gaseous distension of the stomach might, in a great measure mask an enlargement of the heart or a pericardial effusion.* Even in the natural condition, the dulness ceases on lying back, or taking a very full inspiration; and this is another way, as remarked by the author last quoted, of testing the free and unattached condition of the heart and lungs,—for if the dulness still persists over a considerable extent, even under those conditions, we must conclude either that the heart or lungs are adherent, or that the former organ, from its great bulk, or the pericardium, from its extreme distension, cannot recede. In the last case the impulse will be diminished; in the former it will be increased. We must not expect, even in the natural state, in any posture, to find the region of dulness very sharply defined. It is, in truth, shadowed off in proportion to the thickness of the intervening lung, which increases gradually as we recede from the uncovered part of the heart. But the site even of the remoter portion of this latter organ becomes revealed, on proportionably augmenting the force of percussion; for it is only by a pretty sharp stroke that the dulness indicative of a deep-seated solid can be detected. By the same mode of proceeding we may sometimes recognise an enlarged heart, even though little of it may be in contact with the front of the chest; and get the better also of the obscurity which, as we have stated, emphysema is liable to create. When there is great enlargement of the heart, very strong mediate percussion may detect deficient resonance, even in the left lateral and posterior portions of the chest. (*Williams.*) So likewise M. Piorry, who states that the heart in its natural condition is in contact with the parietes of the chest over a space of near two inches in diameter, wherein the dull sound on percussion is very obvious; but that the organ extends from an inch and a half to two inches farther over to the left side, under cover of the lung where likewise its existence may be detected by forcible mediate percussion. The vertical extent of dulness is slightly less than the transverse. The distance of the heart below the top of the sternum is generally from three to three and a half inches, unless when enlargement of the organ exists, or the diaphragm is thrust upward by disease, when it may be reduced to one half less. Immediately after death, the extent of dulness is somewhat less than during life, from the diminished turgor of the walls of the organ.

Structure of the Heart.

It is not our intention to enter at any great length into the natural structure of the heart; a few circumstances, however, which have a bearing on its pathological anatomy may here be mentioned. The cavity of the right ventricle in the adult is broader but less elongated than that of the left, in consequence of which latter circumstance the apex of the heart is formed exclusively by the left ventricle; the distinction between them, or the direction of the septum, is marked externally by a furrow, in which lies the descending branch of the coronary artery and vein. In the fœtus, however, and for some time after birth, the left ventricle is comparatively shorter, and the point of the organ is consequently made up by the two sides almost equally. The tortuous disposition of the muscular fibres of the heart, which baffled the earlier anatomists, has been more successfully investigated in later days by Wolff, Duncan, and Gerdy. The parietes of the left ventricle, according to the last-named anatomist, contain six muscular layers, those of the right only three. The fibres

* "The chicken-breasted conformation of the chest, especially when connected with spinal gibbosity," is pointed out by Dr. Hope as another cause that may prevent the development of dulness on percussion.

of the external layers run obliquely from above downwards, from before backwards, and from right to left; the middle layers take in all respects the opposite directions; and the deep-seated ones, which, by their union, form the fleshy columns projecting into the interior of the cavities, are, for the most part, longitudinal. The most superficial layers, passing along the apex, occupy the entire circumference of the ventricles, whilst the others diminish in length and breadth in proportion as they follow a deeper course; and hence it is that the ventricles are so much thicker at the base than at the point of the heart. All the fibres, whatever may be their disposition in other respects, turn upon themselves in such a manner, at their middle point, as to form a species of loop, the convexity of which looks towards the apex of the organ; and the more superficial the fibres are at one extremity, the deeper seated do they become at the other: thus the most external fibres, for example, become, before their termination, the most internal, in consequence at once of their having been reflected in the manner just described, and also of having traversed the thickness of the ventricle. The extremities of these loops are invariably inserted at the base of the heart around the circumference of the auricular and arterial orifices of the ventricles, either immediately or in a smaller number of instances, by the intervention of the tendons attached to the auriculo-ventricular valves (chordæ tendineæ). The auricles are, according to the same authority, composed of two muscular layers; the one external, the other internal. In the right auricle, the muscular tissue being less abundant than in the left, leaves occasional intervals between its fibres, where the internal and external membranes of the heart are in almost immediate contact; and this proximity helps to explain the frequent coexistence of inflammation of the internal lining of the heart with that of the pericardium.

The subject of the structure of the heart has still more recently been investigated by Dr. Carlyle, who has arrived at conclusions very similar to those of M. Gerdy; whilst M. Filhos, on the other hand, still calls in question the continuity of the external with the deeper-seated fibres; it appearing to him that, after turning from right to left, and from above downwards, in a spiral direction, near the apex of the ventricle, they terminate in a well-marked raphé, from which the internal fibres likewise take their origin. It appears to us, however, from the careful examination of the heart of an ox, the fibres of which had been rendered easily separable by long-continued boiling, that the former view is the true one.

The columnæ carneæ are more numerous in the right ventricle than in the left; but those which act on the valves of the former are smaller than the corresponding ones of the opposite side. The fibrous or albuginous nature of the tissue of which the chordæ tendineæ are formed, and which enters also into the composition of the whitish zones at the base of the valves, surrounding and strengthening the orifices, as well as within the serous duplicature of the valves, enables us to understand why those parts so frequently afford examples of cartilaginous and osseous degeneration. The knowledge of the existence of such a tissue in this situation, together with that of the sero-fibrous structure of the envelope of the heart, should prepare us to expect this organ to be a frequent seat of rheumatic inflammation.

The endocardium, or fine semitransparent polished membrane lining the interior of the cavities, resembles in nature and tenuity the more delicate of the serous membranes; and like the inner coat of the vessels, it readily receives, by imbibition, under certain conditions, the colouring matter of the blood, whence generally originate the reddish stains so often observed within the heart. It is in neglected inflammation of this membrane, according to M. Bouillaud, an author to whom we shall have occasion very often to refer, that a great majority of the organic diseases of the heart have their source, and especially in that portion of it which lines the valves and orifices, where it is naturally thicker than in other situations, and necessarily exposed to a greater degree of stress and friction. Chronic inflammation, it is supposed, may lead

not merely to morbid thickening and inequality of this structure, but also to the effusion of coagulable lymph on its surface, as well as to hypertrophy and degeneration of its subjacent cellular and fibrous tissues, inducing immediately diseases of the valves and orifices, and secondarily, thickening of the walls of the heart, and enlargement of its cavities. Though in its natural condition it can be detached only in minute shreds, yet in certain states of disease its adhesion to the subjacent tissues becomes so much diminished that large patches of it may be raised entire. Around the contours of the orifices or base of the valves, as well as in the situation previously indicated, the inner and outer linings of the heart come into very close approximation, only a very thin layer of connecting cellular membrane intervening; so that here also the transmission of inflammation between the two surfaces is peculiarly favoured.

Weight and Measurement of the Heart.

It would obviously be very desirable towards assisting us in the appreciation of certain cases of enlargement and diminution of the heart, to possess some definite standard of its normal magnitude. This, however, taken in an absolute or mathematical sense, is evidently unattainable, for the size of the heart, like that of all the other organs, is susceptible of various shades of difference, all of which may yet be within the natural limit, or the limit of health. All, then, that we can rationally attempt is, either to establish a rough comparison between its size and that of some other organ appertaining to the individual examined; or else to obtain an approximative or average value for it, in figures, deduced from a large number of particular cases. Of these two expedients Laennec contented himself with the former, laying it down as a general rule that the healthy heart was ordinarily about equal in size to the fist of the subject to which it belonged, a rude standard of comparison, of which the chief recommendation is the facility of its application. The walls of the left ventricle, he adds, are about double the thickness of the right, and sufficiently firm to prevent their falling together and obliterating the cavity on being cut across; the right ventricle is a little larger, and from the thinness of its walls should in the natural condition collapse on incision. Since the time of Laennec, however, in consequence of the vogue of the numerical method in other branches of pathology, several French, German, and English physicians have endeavoured to solve the physiological problem alluded to by the system of averages expressed in numbers, setting forth thus the medium weight, and measurements of the heart. Thus the average weight of the heart of the adult in its normal condition, and after being emptied of its blood, and having the great vessels cut away, was estimated by M. Cruveilhier at 6 or 7 ounces French*; by M. Lobstein, and by Meckel so high as 9 or 10 ounces, the latter adding that its weight is to that of the whole body about as 1 to 200†; whilst by M. Bouillaud and Dr. Clendinning (whose results, having apparently been arrived at from a much larger number of observations, made with peculiar accuracy, are especially worthy of confidence) it is stated at between 8 and 9 ounces for the adult male; the average weight of the female heart according to Dr. Clendinning, being about an ounce less. A heart in a state of hypertrophy will weigh from 11 to 24 ounces, or even more. Laennec mentions one of two pounds and a half, and Dr. Mason Good speaks of some still more enormous specimens; but as they do not expressly state whether or no the blood and coagula had been removed from the interior, we cannot rely on their estimate. A heart in a state of atrophy, on the other hand, has been found to weigh only from five to six or seven ounces; so that the balance, when taken in connection with previous symptoms, obviously furnishes us with a very satisfactory test of changes in the heart's mass. We cannot, however, with any

* The French ounce is to the English ounce avoirdupois about as 15 to 14.

† In infancy the heart, and more especially its cavities, are *relatively* much larger than in adult age.

safety estimate the quantity of matter which it contains by the eye alone, or even by measurement; for as the experiments of M. Jules Pelletan have shown, there is a very considerable difference in hearts in respect to specific gravity.

The recent researches of M. Bizot, which were carried on with so much seeming accuracy, and on so extensive a scale as to entitle them to a peculiar degree of credit, have led to the establishment of some very unexpected results, which stand in direct opposition to the previous surmises of the highest authorities in medicine. Thus, he has found that the size of the heart continues to increase regularly in proportion with advancing age; and that this depends partly on the gradually augmenting capacity of both ventricles, and partly on the steadily increasing thickness of the walls of that of the left side especially, those of the right ventricle remaining almost stationary. In respect to the influence of stature, he has arrived at a startling conclusion, which, though his data are numerous, stands perhaps in need of additional confirmation based on a still larger induction of particulars — namely, that in tall persons the mean dimensions of the heart are actually less than in middle-sized individuals, and that this holds especially in respect to its breadth. The width between the shoulders he has found to afford a much better criterion of the probable size of the heart than the height. It is right to state, that Dr. Clendinning's investigations have led him to acquiesce entirely in M. Bizot's assertions in respect to the effects of advanced age and height on the size of the heart. Thus, whilst in individuals above sixty all the other organs have evidently suffered a loss of weight, he finds the heart to be increased, on an average, by at least one twelfth. Dr. Clendinning is however at variance with Bizot, no less than with Lewis, in respect to the state of the heart in phthisis, in which disease he has, like Andral, generally found it in a very appreciable degree enlarged; the wasting characteristic of the disease falling rather on the external parts, or organs of locomotion, than on the internal viscera, as he has proved indisputably by the use of the balance.

The mean length of the heart, measured from the base to the apex of the left ventricle, was found by M. Bouillaud slightly to exceed 3½ inches *; the breadth at the base was a fraction more than this; the thickness of the base, measured from before backwards, was about 2 inches; the circumference at the same part almost 9 inches; the thickness of the septum measured, in the single instance in which it was examined, 11 lines, but this we think is quite above the usual average. Meckel states it at from 4 lines to half an inch; the latter measurement, as it appears to us, being nearest the truth. The mean thickness of the left ventricle, measured near the base, generally the thickest part, was nearly 7 lines, that of the right about 2½ lines; so that Laennec would appear to have somewhat undervalued the difference of thickness of the two ventricles, in stating the one to be only a little more than double as thick as the other; the real proportion being more nearly as three to one. In infancy, however, no such great disproportion exists; and in the fœtus their walls are nearly of equal thickness. The mean thickness of the left auricle is about 1½ line, that of the right about 1 line.

The capacity of the right cavities of the heart has been correctly stated by most anatomists, as somewhat exceeding that of the left. The difference, however, is, as we should expect, not very considerable; and even less than from the ordinary state of distension of the right side of the organ after death it would at first sight appear to be. Bizot estimates the difference somewhat higher than Laennec or even than Bouillaud. The cavity of the left ventricle in its natural condition is about equal in capacity to a moderate-sized hen egg.

The mean circumference of the left auriculo-ventricular orifice may be stated at about 3½ inches, that of the aortic orifice at about 2½. The corresponding orifices of the right side are usually, as might be anticipated from what has been said in the last paragraph with respect to the comparative size of their

* Meckel states the whole length of the heart at five inches and a half, of which four for the ventricle and one and a half for the auricle.

cavities, slightly larger (Bizot says, on an average, by about nine lines): this, however, if Bouillaud be correct, is not universally the case.

The depth of the mitral and tricuspid valves is from 8 to 9 lines; that of the pulmonary and aortic about $5\frac{1}{2}$ or 6; those of the right side, in each instance ordinarily exceeding by a fraction those of the left, though somewhat inferior to them in strength. How great a deviation from the above measurements may be induced by disease appears from the following facts. The circumference of the heart in a state of hypertrophy has been found occasionally to measure 12 inches; the ventricles in length $5\frac{1}{4}$ inches; or even more, the wall of the left ventricle from 7 lines in thickness to considerably upwards of an inch; that of the right from 3 lines to $4\frac{1}{2}$ and upwards. The capacity of these cavities in cases of dilatation, with or without hypertrophy, is occasionally doubled. The circumference of the ariculo-ventricular orifice of the left side was increased in one of M. Bouillaud's cases of hypertrophy of the ventricles to $4\frac{1}{4}$ inches, whilst in another it was contracted, in consequence of diseased valves, to 2 inches. The circumference of the aortic opening was enlarged in one instance to about $3\frac{1}{2}$ inches, and diminished in another to less than 1 inch, and still more extreme cases, than those are occasionally met with.

In respect to all the above measurements, weights, and proportions, it must never be forgotten, when we go about to apply them practically as standards of comparison, that they are mere averages, deduced, moreover, from but a limited number of cases. Consequently every slight deviation from them, whether in excess or deficiency, is not at once, and without further consideration of the circumstances of the case, the age, sex, make, and muscular development of the individual, to be set down as evidence of disease of the heart. Thus, for example, the heart of a man built on a very broad scale may weigh some ten or eleven ounces, whilst that of a small and delicate female on the contrary, may not exceed six or seven ounces, and yet there shall not be disease of the organ in either case.

Again, in estimating the thickness of the walls of the heart, we must take simultaneously into consideration the apparent size of the cavities which they bound, the previous symptoms, and the peculiar mode of death; for when from a considerable reduction of the mass of circulating fluids, by profuse hæmorrhages, extreme evacuations, or a long-continued low scale of diet, the muscular parietes, in order to accommodate themselves to their diminished contents, have become notably contracted, a proportional thickening will necessarily exist. From this cause, the walls of a heart actually in a state of atrophy have sometimes been found, as M. Bouillaud remarks, apparently even thicker than natural. If these modifying circumstances be kept in mind, the above standard can scarcely fail of being serviceable, at least to the young pathologist, by giving a definite direction to his anatomical researches, and furnishing him with a useful basis of comparison, till his eye has been in some degree formed by the frequent inspection of morbid parts. *

* Of several measurements of the heart and attempts to appreciate its relations to different points of the chest, made with the assistance of a very accurate observer, Dr. J. Macdonnell of the Richmond Hospital, Dublin, some already have been stated, and a few others may be subjoined here. The principal object was to determine the relation of the orifices, amongst themselves and to the surrounding walls of the thorax. Similar investigations have been made by Dr. Hope and others, with nearly, but not precisely, the same results.

The point, the establishment of which was especially aimed at, was, the impossibility of discriminating disease of one orifice from that of another, merely by applying the stethoscope over the situation where the morbid sounds are produced, seeing that in no instance are the most adjacent points of any two of the orifices much above an inch apart; and in respect to most of them not above the third of that distance.

The aortic and left auriculo-ventricular orifices are nearly in contact at their most adjacent points; the interval between the former and the orifice of the pulmonary artery, which stands highest, is likewise very inconsiderable, not exceeding a few lines. The distance between the nearest parts of the pulmonary artery and of the right auriculo-ventricular orifice, though greater than in the other instances, scarcely exceeds an inch. The bases of the *auriculo-ventricular* valves are situated a very little lower or nearer the apex of the heart than the *aortic* valves, viz. about a quarter of an inch on the left side, and half an inch on the right. At least one third part of the circumference of each of the auriculo-ventricular orifices and their valves, thus lie

As disease of the heart is rarely, if ever, an affection of the whole organ, it is not from a mere general and superficial inspection of its magnitude, such as the old pathologists seem to have rested content with, that any very satisfactory knowledge is to be expected. It is only by the patient examination of all its component parts in detail, their texture, composition, size, form, and mutual adaptation, that a complete insight into the actual condition of the organ, or an explanation of the various functional derangements which preceded death, can reasonably be hoped for. To make a satisfactory post-mortem examination of the heart, we should begin by ascertaining the state of its investing membrane; and then proceed to lay open its several cavities, so as to enable us correctly to estimate their size, the thickness of their walls, the condition of their valves, tendons, orifices, lining membrane, vessels, and nerves. Perhaps the best method of displaying the interior of the heart, without injury to its orifices, nerves, or tendons, is that adopted by Dr. Williams; namely, to make an incision from the apex of the left ventricle, close along the anterior groove indicative of the septum, taking care to cut between, and not across, the semilunar valves, or rather to stop at first a little short of the aortic orifice, until its ventricular aspect has been examined; whilst, to get a good view of the mitral valve, a second incision is to be carried from the apex up along the middle of the flat surface of the heart. In the right ventricle, the first section is likewise to be carried along the anterior edge of the septum; but the second, in consequence of the different position of the tricuspid valve, should commence in the middle of the first, and be carried across the cavity at right angles to the heart's axis, till it meets the posterior groove. The auricles are to be laid open by a crucial incision, which displays their ventricular and venous orifices uninjured, their septum, the ossa ovalis, &c.

Motions of the Heart.

Notwithstanding all the attention recently bestowed upon the subjects of the sound and motions of the heart, some obscurity still exists in respect to them. Certain facts, however, appear to have been at length satisfactorily ascertained, and to these chiefly we shall endeavour to confine ourselves, leaving the more debateable ground to works treating expressly of the physiology of this organ.

It is known, in the first place, then, that the auricles and ventricles contract

close under the semilunar valves of the aorta and pulmonary artery; so that a stethoscope placed over the latter would necessarily, as already stated, cover a considerable portion of all the four orifices, even if the heart hung vertically in the chest, and obviously a still greater part of their circumference in the actual position of the organ, with its axis forming nearly half a right angle with the parietes of the thorax, and deviating so much to the left side anteriorly, where the stethoscopic examination is chiefly made.

A horizontal line drawn through the under edge of the sterno-costal articulations of the fourth ribs will cut across nearly the middle of the length of the *mitral* valve when drawn outwards and downwards by its tendinous chords and columnæ carneæ, and pass about two or three lines above that portion of the *tricuspid* which most nearly approaches it, the latter valve lying underneath the sternum, and the former immediately to its left. A frequent repetition of our observations, and experiments with needles long enough to pass quite across the thoracic cavity and its contents, lead us to believe that the relation of the heart to the parietes is not in all cases accurately the same, though the differences are too inconsiderable to throw any difficulty in the way of diagnosis. They may, however, serve to account for the circumstance of the results given here and at a former page, differing slightly from those of Dr. Hope, who states (p 3.) that "a line drawn from the inferior margins of the third ribs across the sternum passes over the pulmonic valves, a little to the left of the mesial line, and those of the aorta are behind them, and about half an inch lower down." Again (p. 4.), "The auricular orifices are situated opposite to the interspace between the third and fourth ribs, and the right is rather lower than the left."

If the heart hung vertically within the chest, the aortic valves would be at a considerably lower level than the pulmonic valves, as stated by Dr. Hope; but by the oblique position of the organ, intermediate between vertical and horizontal, this distance, if considered in linear relation to the external surface of the chest and the results of stethoscopic examination, is notably diminished.

The depressed condition of the ribs in the dead body, like a forced expiration in the living, will tend to make the heart in the corpse appear in a slight degree higher up, in relation to the anterior walls of the thorax, than its natural medium site; and for this allowance ought to be made.

alternately, the systole of the auricles being instantly followed by that of the ventricles, and this in its turn by the ventricular diastole, and a momentary period of repose. The full dilatation of the auricles is simultaneous with the contraction of the ventricles; the auricles being distended, a portion of their contents overflows into the relaxing ventricles, and the appendices, after the momentary pause just mentioned, again acting, stimulate the ventricles, by the injection of an additional quantity of blood, to renewed exertions, — a stimulus the more readily obeyed from the inherent tendency in this muscle to periodic action.

Such is the order of succession, now commonly known as the *rhythm of the heart's motions*. Of the whole time occupied by the several elements, which go to make up a complete beat of the heart, somewhere about a half is consumed in the contraction of the ventricles; a fourth in their diastole; and the remaining fourth, as judged of by the ear, is spent in apparent repose, though really the latter portion of it is taken up by the silent contraction of the auricles and their appendices. The impulse of the heart against the ribs, and the pulsation of the great arteries as they arise from it, are synchronous with the ventricular contraction, as has been proved by direct experiment.* The pulse of the arteries at a greater distance from the centre of the circulation is felt a moment afterwards, the interval of time being directly proportional to the distance from the heart. The cause of this retardation is to be found in the yielding and elastic nature of the tubes in which the blood is conveyed, in consequence of which a minute portion of time, as well as a part of the onward force of the ventricular wave, are consumed in effecting the dilatation of the arterial walls. The interval which occurs even in respect to the remoter arteries is still very slight, not exceeding perhaps a quarter of a second, and yet with attention and a little practice it is readily appreciable. Any one may perceive it in his own person, especially when the pulse is rather slow, on applying the fingers of one hand to his posterior tibial artery, as it is passing behind the inner ankle, whilst the fingers of the other are simultaneously placed in contact with that portion of the chest where the heart's impulse is most perceptible.

In the natural condition of the heart, in most postures of the body the apex alone seems to be concerned in giving the impulse felt externally. Yet in the prone position, or when the body is leaning much forward and turned a little towards the left side, after a full expiration, and still more remarkably in cases of enlargement of the organ, its whole mass appears to be impelled forcibly against the walls of the chest.

Various explanations of the impulse of the heart have been attempted; thus it has been ascribed to the reaction of the blood in quitting the ventricles, — to the tilting forward of the whole organ, by a supposed sudden diminution of the aortic curve, under the influence of the straightforward impulse of the projected column of blood, — to the simultaneous distension and prolongation of the ascending aorta and pulmonary artery, — to the coincidence of the dilatation of the auricles with the ventricular systole, — to the forcible injection of the ventricles by the auricles (an obvious error), — and, finally, it has been attributed, and with much more probability than appertains to any or all of the other supposed causes, to the sudden tension of the ventricles in their systole, with the accompanying rapid jerking upwards of the apex, in consequence of the greater length of the anterior fibres of the heart, and probably of something in the mode of their disposition which has not yet been accurately ascertained. Any one, indeed, who has ever grasped the heart of a living animal in his hand, must have become satisfied, from the force with which his fingers were separated during the ventricular systole, that an adequate explanation of the stroke of the heart was to be found in the action of the ventricles alone, without being much indebted to any of the other supposed causes. A movement of this kind is quite obvious to the sight in the heart of an animal, even a warm-blooded one, for many

* Drs. Hope and Williams; the Dublin committee of the British Association, for the investigation of the sounds and motions of the heart, &c.

minutes after its being quite emptied of blood, and even removed altogether from the body.

The auriculo-ventricular valves are slightly raised from their contact with the sides of the ventricles, by the tendons passing into them from the columnæ carneæ, synchorously with each ventricular contraction, so as to facilitate the insinuation of the blood behind them; and, by means of this latter, their complete closure is eventually effected, and all reflux in the natural condition prevented, at least in the left side of the heart; for, with respect to the right side, it has been remarked by Hunter, that the valves do not accurately close the auricular and arterial orifices,—this being a provision of nature, he conceived, to allow a partial reflux into the auricle, when, from any cause, the passage of blood through the delicate texture of the lungs is obstructed, as is often the case during violent efforts, narrowing of the left apertures of the heart, disproportionate magnitude of the right cavities, &c., and similar views, have recently been advocated by Mr. Adams and Mr. King, who look upon the tricuspid as exercising a kind of safety-valve function. The dilatation of the ventricles is effected in part by their own elasticity, which will suffice to draw a certain quantity of blood into them; and is probably completed by the auricles transferring, as they contract, an additional portion. Some physiologists call in, moreover, the aid of an active dilating power in the heart, but of the reality of this, though not improbable, no absolutely convincing proof has yet been adduced. The feebler muscular structure of the auricles, and the absence of a valvular apparatus at their great venous orifices, indicate sufficiently that the propulsive power of these cavities is but slight in comparison with that of the ventricles, and that they play consequently a very inferior part in the business of the circulation.

For its motions, the heart, like all other muscles, is primarily indebted to its own inherent contractility, as is obvious from their continuance long after its removal from the body. For nervous influences it is chiefly dependent on the ganglionic system, and not on the spinal marrow. This opinion, advocated by Willis and Bichat, and subsequently impugned by Legallois, may now be considered as fully established by the experiments of Dr. W. Philip, Mr. Clift, and Brâchet. The pathological facts, recorded by Lallemand and Lawrence, of the pulsation of the heart in a monstrous fœtus, where the brain and spinal marrow were entirely deficient, afford additional evidence, if any were wanting, that these organs are not essential to its action. Injuries of the spinal cord, it is true, powerfully affect the heart; but this is now known to take place merely through the medium of sympathy, and similar results equally ensue from extensive and destructive injuries of other parts of the system. That the heart is remarkably under the influence of mental emotions is familiar to every one —but in this there is no contradiction to the views just expressed, nor any infringement of general analogy.

Natural Sounds of the Heart and Bloodvessels.

When we apply the ear to the region of the heart, with or without the intervention of the stethoscope, two sounds are heard, of which the first is duller and more prolonged, synchronous with the pulse in the immediate vicinity of the heart, and consequently with the contraction of the ventricles. The second, which instantly succeeds it, is of a more abrupt and clearer character, and is followed by an interval of silence.

The first sound is loudest over and below the middle of the ventricles; that is, over that portion of the heart which is in contact with the parietes; the second over the semilunar valves, and for a short way upwards along the sternum. They are most easily distinguished, by the uninitiated, in thin individuals of a slight and narrow make, and when the pulse is somewhat slow. We may occasionally, in particular states, hear them very distinctly in our own persons, especially when lying on the left side, and when the pulsations have been rendered

more energetic by violent exercise or the use of stimulants; and in certain disorders of the heart this audibleness of its workings becomes almost a constant, and with some patients a very distressing, symptom. These sounds are sometimes audible even to a bystander at a little distance from the patient. Thus Laennec states that he had heard them at various distances from two inches to two feet from the chest through the medium of the air alone; and he speaks of cases, on hearsay, where the beating of the heart was heard in an adjoining chamber to that in which the individual lay. M. Breventani, a recent Italian writer, has met with two cases in which the morbid sounds of this organ were audible at a considerable distance, which in one is specified as being not less than three paces.

According to Laennec and many of his followers, the sounds heard under the inferior part of the sternum belong to the right cavities;—those under the cartilages of the left lower true ribs, to the left. In cases of the morbid enlargement of particular parts of this organ, such distinctions may doubtless be attempted with success, but in its natural condition we agree with M. Bouillaud in doubting their practicability, when we take into consideration the limited extent of these cavities, their close apposition, and the manner in which the right ventricle lies over, and in front of, the left.

The intensity of the heart's sounds diminishes in the natural condition in proportion chiefly to the distance from the præcordial region. Laennec has certainly limited the extent of surface in which they are audible, in a healthy well-proportioned individual of moderate fatness, within too narrow bounds, when he confines it to the præcordial region alone. In very fat persons he states that it is confined to a space of about an inch square. In narrow-chested thin individuals and children, these sounds may often be heard over the greater part of the thoracic cavity, posteriorly as well as anteriorly; in the neck, and also in the epigastrium, though no disease of the heart exists: and in infants that may sometimes be heard even as low as the buttock.

Disease of the heart itself, or of the neighbouring organs, produces remarkable modifications in regard to the intensity and mode of diffusion of these sounds, which are of high importance in respect to diagnosis. Thus they may appear even louder at remote parts of the chest than in the more immediate proximity of the heart; as, for example, when a portion of the lungs is solidified and rendered a better conductor of sound by inflammation, or by tubercular infiltration or condensation around a phthisical cavity, or by the compression resulting from a pleuritic effusion, or by the development of a tumor within the chest, or the encroachment of an enlarged liver on this cavity.

When, from morbid changes inherent in the heart itself, variations arise in regard to the extent in which its sounds are perceptible, they manifest themselves, according to Laennec, successively in the following order:—1. Sounds audible in the left side of the chest, from the axilla down to the corresponding hypochondriac region; 2. in the right side, over the same extent; 3. in the left posterior portion of the chest; 4., but rarely, in the right posterior region. But the practical applicability of this scale, to which Laennec attributed much importance in determining the nature and degree of cardiac disease, is obviously greatly limited by the interference of the several extraneous circumstances to which we have just alluded.

The *physical cause* of the sounds of the heart has been the subject of much discussion. To enter upon a minute estimate of all the theories proposed for their explanation would be inconsistent with the practical nature of this work; we shall therefore limit ourselves to stating our conviction that the great weight of evidence is in favour of the two following causes:—muscular contraction for the first sound, and valvular reaction for the second. It has been rendered in the highest degree probable, by the experiments of Dr. Williams and others, that the *first* sound is an example of the "bruit musculaire," or sonorous muscular contraction, of Erman, Wollaston, and Laennec. All powerful muscles, as the biceps of the arm, the masseter, or the abdominal muscles, if thrown into

strong action, give rise to sonorous vibrations which may readily be heard in our own persons with the aid of a flexible ear-tube. That the muscular sound of the heart may occasionally be modified by the stroke of the organ against the side of the chest in the case of violent palpitation, and also in some degree by the action of the auriculo-ventricular valves, is not denied; but the first sound is not mainly dependent on either of these, for it is still audible even after the removal of the heart from the chest, and when consequently it has no longer either the thoracic parietes to strike against, or blood enough to ensure the action of the valves (*Dublin and London Heart Committee—Williams*). Even the complete obstruction of these valves, by inverting the auricles and thrusting them thus into the auriculo-ventricular openings, was not found to annihilate the first sound. After the promulgation of such facts, it is surprising to find that so able a writer as M. Bouillaud should persist in attributing it solely to valvular action: and, even altogether independent of these facts, the prolonged character of the sound appears quite incompatible with the sudden and momentary tension or collision of such membranous structures.* This promulgation reaches its maximum in cases of great hypertrophy, and especially when the ready escape of the blood from the ventricle is interfered with by the diseased narrowing of the arterial orifice.

With regard to the *second* sound, it has been rendered equally probable by the experiments of Elliot, Carswell, Rouanet, Carlyle, Williams, Hope, and the committees already alluded to, that it depends on the reaction of the column of blood in the aorta and pulmonary artery against the semilunar valves; for it is found to cease, or in some cases to be supplanted by a hissing noise, on these valves being hooked up, and held nearly immoveable against the sides of their respective vessels, by a curved needle introduced through their walls from without. It is likewise put an end to on arresting the current of blood, either by cutting across or compressing these vessels near their origin, and so preventing the falling back of the arterial column against the valves. Making a small opening into the great arterial trunks near their source very materially modifies the second sound (*London Heart Committee*); and even cutting across the carotid, by diminishing the arterial tension, greatly enfeebles the same, as does likewise whatever lowers the projectile energy of the ventricles, the reaction of the great vessels being of course proportional thereto. The circumstance of these sounds being loudest in the region of the semilunar valves, and commencement of the aorta and pulmonary artery, tends still further to confirm the truth of this hypothesis.† We are inclined at the same time to think it probable that the second sound, though mainly produced in the way just stated, may yet in the natural condition, and when the heart is acting energetically, be reinforced by the diastole of the ventricles: we do not mean to assert that this has been as well made out by experimental evidence as the cause first mentioned; but if, as is now known to be the fact, the relative change of place undergone by the constituent molecules of a muscle in the act of contraction be accompanied by the production of sound, we should expect that the elastic recoil of so powerful a muscular organ as the heart, *i.e.* the rapid return of these same molecules to their former state, would likewise be accompanied by the same phenomenon, though differing somewhat in character or intensity.

* According to Dr. Hope, the causes of the first sound are compound: consisting, 1st, of valvular sound (and to this he seems still to attribute the most importance); 2d. the sound of extension, — a loud smart sound, produced by the abstract act of sudden jerking extension of the braced muscular walls; 3d. a prolongation, and possibly an augmentation, by "bruit musculaire." Page 50.

† The discovery of this theory of the second sound of the heart is claimed by Dr. Carswell, and was first publicly announced by M.D'Espine, in a dissertation read by him at the Academy of Medicine at Paris, in July, 1831, though it was made known by Dr. Carswell as early as 1829. There is, in the museum of University College, a drawing (dated 1829) of the case of aneurism of the aorta observed by Dr. Carswell, in the Hospital of La Charité, the physical signs of which case first suggested to him this now almost universally received theory.

[Dr. Billing attributes both sounds to the valves alone. See Essay read at the Hunterian Society, Feb. 9. 1832, reported in the *Lancet*, May 19. 1832; also *Principles of Medicine*, Preface, p. 21.]

Morbid Sounds of the Heart and Bloodvessels.

Amongst the most common changes in the sounds of the heart, is *increase* or *diminution of intensity*. Thus, in the first place, they may become so feeble as to be heard with difficulty; and this may depend either on general debility of the whole system, or on that of the heart in particular; on obstruction of the pulmonary circulation; on excessive afflux of blood to the heart; on softening of this organ; or, finally, on its extreme hypertrophy, the overgrown muscular mass contracting less perfectly than in the natural condition, and being ill adapted for the production of sound, and at the same time a bad conductor of it. The sounds of the heart may become so loud, on the other hand, as to be audible, as we have already seen, at some distance from the chest. The great majority of the latter cases, as mentioned by Laennec, are quite independent of organic lesion, being mostly instances of nervous palpitation, or the temporary result of violent muscular exertion, the natural sound being not only increased itself, but reinforced moreover by the addition of a metallic ringing sound, caused by the unusual impulse against the walls of the chest.* Dilatation of the ventricles, and thinness of their parietes, are also particularly favourable to the augmentation of the cardiac sounds, and tend in a remarkable degree to assimilate the first sound to the second.

The natural character of the sounds of the heart may be still further altered or masked by the supervention of the *bellows sound* (bruit de soufflet), of various qualities or degrees of intensity; the *simple blowing sound*, the *hissing*, *sawing*, or still hoarser *rasping* sounds, all of which are occasionally to be heard in the arteries also, and more especially in the carotid and subclavian, the abdominal aorta, and the great arteries of the limbs; as also in the uterine, or adjacent arteries, during pregnancy. Even in the natural state of the arteries, a species of low murmur, compared by Bouillaud to that produced by rubbing the point of the finger against the thumb, as in the action of giving a fillip, accompanies each pulse-wave. On pressing more firmly with the stethoscope, this becomes converted into a "bellows murmur." This has appeared most audible when, from deficiency of blood, the arteries are less distended than usual, and also when the blood is more watery than ordinary. The sound in question depends, according to Bouillaud, on friction, and may be imitated by injection of the arteries in the dead body, or by driving a fluid in jets through any elastic tube. Dr. Corrigan, on the contrary, from observing the bellows-sound to be most intense beyond the point of pressure with the stethoscope, and that it was produced by any condition tending to disturb the natural equable motion of the blood, was led to conclude that it depended, 1st, on a current-like motion of the fluid, tending to produce corresponding vibrations in the sides of the cavities of the heart or arteries; 2dly, on diminished tension of their parietes, in consequence of which they are more easily thrown into such vibrations. Dr. Williams and Dr. Todd, on the other hand, from a somewhat similar set of experiments to those previously instituted by Dr. Corrigan, came to a different conclusion; namely, that a certain resistance or impediment to a liquid current is the essential physical cause of all murmurs produced by the motion of fluids in elastic tubes; and that any particular condition of the walls of the tube beyond the obstructing point is not essential to their production.† It is possible

* Dr. Davies mentions, in his lectures, having heard the beating of the heart of a patient (a female during menstruation) at five or six yards distance. Laennec when on his death-bed, heard his own heart beat very distinctly, and it was audible at some inches distance to the bystanders. He had been blooded shortly before. He ascribed the phenomenon to distension of the stomach with air, as it ceased immediately after eructation.

Dr. Hope doubts the possibility of sound ever being produced by the impulse of the heart against the walls of the chest; believing this organ to be always, in consequence of the atmospheric pressure, necessarily in contact with the parietes. As to the accidental metallic "cliquetis," sometimes heard during palpitations, he ascribes it to the apex, as it glides forwards and upwards in systole, catching against the inferior margin of the fifth rib, having observed it to occur only in thin subjects, and that it can be done away with at once by pressing with the stethoscope into the intercostal space, so as to obliterate any internal depression at this part.

† Dr. Corrigan, as appears from a recent paper in the *Dublin Medical Journal*, still adheres

that here, as in so many other cases, truth may lie between; and that we might be justified in adopting an hypothesis combining the views of both parties. Thus it seems nowise improbable that the sonorous vibrations in question are caused by a current-like motion of the contained fluid; but that this acts first, and chiefly, on the narrower portion of the canal, where the friction is greatest, and the pressure of fluid on the farther side least; whilst the vibratory motion so generated is immediately propagated to the laxer parts beyond.

There is another rarer modification of this phenomenon, first noticed by Laennec, but met with by him only in the arteries, wherein the blowing sound assumes somewhat of a *musical* or whistling character; occasionally ascending and descending through two or three notes of the gamut in a sliding or slurred manner, and accompanied by a slight thrill in the artery perceptible to the fingers. Of its affinity to "bruit de soufflet" we have proof in the fact of its sometimes supervening insensibly on the ordinary bellows-murmur when the patient is agitated, and again falling back gradually into its former character. It may be either intermittent and synchronous with the pulse, or continuous. It seemed generally to Laennec to be connected with a nervous habit of body, or with a chlorotic condition, quite independent of organic disease. He cautions us against confounding it with a somewhat similar, or chirping, sound, which is occasionally produced in some of the bronchial ramifications from the presence of mucus and the pulsation of the subclavian artery against the top of the lungs. M. Bouillaud has twice met with a similar musical sound in the heart itself, and compares its varieties to the cooing of the woodpigeon, the chirping of small birds, or the sibilant râle of bronchitis. It is supposed by him to be connected with narrowing of the orifices or disease of the valves, and to be only a very intense form of the bruit de soufflet. M. Rouanet has also met with it in the same situation, as have likewise Drs. Forbes, Hope, and Elliotson; and in some few of these instances it has been connected with the existence of a long vegetation attached to the mitral valve.

To a singular variety of the bellows-murmur, of a remittent booming or whirring character, occasionally heard in chlorotic and nervous subjects, with too fluid or watery a state of the blood and an easily accelerated circulation, particularly above the inner end of the clavicle in the neighbourhood of the carotid and subclavian artery and jugular veins, M. Bouillaud has given the fantastical name of "bruit de diable," from its similarity to the noise produced by the well-known French toy resembling a double humming top, called the "devil on two sticks." It is not absolutely intermittent or interrupted, like the ordinary bellows sounds, nor yet equably continuous like another species in which the sounds accompanying the two motions of the heart run, as it were, into one; but, though sustained or prolonged from pulse to pulse, it has remissions of intensity, and a periodic swell, bearing a fixed relation to the diastole of the arteries, in which vessels, according to the author just named, it has its origin. Dr. O. Ward has, however, rendered it probable that its seat is very often, if not always, in the external jugular veins (*Med. Gaz.* April, 1837); an opinion which is likewise embraced by Drs. Williams and Todd, and has been still more recently advocated by Dr. Hope. Very slight circumstances suffice to alter its character, or to interrupt it: such as, a change of posture; relaxing the side of the neck on which it

to his original opinion; and undertakes to prove that impediment in a tube alone is not sufficient for the production of sound,—for if a second and more considerable constriction be made lower down, the bellows-murmur in the upper and original one ceases as soon as the whole tube has become full and tense. His views are, as usual, supported with much ingenuity; and the question at issue, though supposed to have been set at rest by the investigations of the London Heart Committee, must be considered perhaps as still undecided. It seems to us, however, that he does not take sufficient account of the diminished velocity of the fluid, and consequent reduction of friction, taking place in the arrangement just alluded to. The increased pressure of fluid against the remote side of the upper obstructed portion must also tend to impede the production of vibrations in the part. In respect to the sound generated at the very extremity of a tube discharging a fluid, he supposes the surrounding air to take the place of the flaccid parietes of the tube, and to respond to the vibrations of the rushing stream so as to produce an audible murmur.

is heard; pushing over the larynx; muscular efforts which impede the respiration, and the transit of blood through the lungs and right side of the heart; increased pressure of the stethoscope, or compression of the vein above: whilst, on the other hand, it is increased in intensity by whatsoever puts the vessels on the stretch (as averting the head and raising the chin), and which, by narrowing their calibre, augments the velocity of their current. Dr. Ward admits that it may sometimes be modified by the proximity of the carotid arteries, so as to appear augmented at each ventricular systole. Dr. Williams does not consider it essentially a morbid sound, as it may be produced at pleasure in the healthiest subject by the pressure of the stethoscope in the region indicated above, so applied as to effect only the venous current. It has likewise been observed, though more obscurely, in the superficial veins of the limbs. An analogous sound is mentioned by Andral under the title of "bruit de mouche," from its close resemblance to the buzzing of a fly. It differs, however, in being continuously sustained and equable, not being periodically reinforced like that just described; and is supposed by him, though perhaps erroneously, to have its seat constantly in the carotids, and always to indicate a chlorotic condition, and the propriety of administering iron and other tonics. It seems probable, from the investigations of the gentlemen previously mentioned, that this sound also very commonly originates in the veins, and that the pressure of the muscles of the neck may sometimes be concerned in its production.

The *causes* of the *arterial* abnormal sounds are reducible to the following heads: — 1. Compression as by a tumor or the stethoscope (murmur blowing). 2. Contraction of calibre, roughness of the lining membrane, or other partial impediment (murmur blowing, musical, rasping, &c.). 3. Sudden dilatation, which is so often observed in the ascending aorta, and sometimes in the pulmonary artery, rendering their diameter disproportionate to that of their orifices (murmur, generally grating). 4. Aneurism (murmur, whizzing or grating). 5. Passage of blood through an accidental opening in an artery into a vein (aneurismal varix; murmur generally whizzing or grating). In addition to these causes, which are obviously of a mechanical nature, must be enumerated augmented action of the heart, a thin condition of the blood, and a nervous habit; for these conditions seem adequate not merely to augment and modify the morbid sounds, but even alone, or at least in the absence of any permanent obstructing cause, to originate them. (*Williams.*)

Narrowing of the orifices of the heart also, or an irregular, rugose, shortened, or imperfect condition of the valves, connected generally with cartilaginous or ossific degeneration, obstructing the onward course of the blood, or permitting of reflux, is commonly accompanied by some of the above-described varieties of morbid sounds. This is the result of M. Bouillaud's experience, and, we believe we may add, of most physicians who have seen much of disease of the heart. The frequency of the coincidence was admitted even by Laennec, though he did not look upon the latter as the immediate or necessary effect of the former. M. Piorry, however, asserts that neither the bellows-sound nor any of its modifications were present in one case out of twenty within his own sphere of observation. Now, as we have already stated in another place (*British and Foreign Medical Review*, No. ii. p. 451.), when negative evidence is thus set in opposition to positive, we are impelled by a law of our nature to give most credence, "cæteris paribus," to the latter, and to suppose it more probable that existing sounds may have escaped notice on the one hand, than that their existence should have been fancied and recorded when they had no reality on the other. We do not, however, deny that cases of contraction and ossification may occasionally present themselves unaccompanied by any abnormal sounds. They are, however, we apprehend, extremely rare, and form only the exceptions, and not the rule, as M. Piorry would have us believe. We are equally prepared to admit that these sounds often exist without its being possible to connect them with any obvious physical lesion.

Bruit de soufflet may originate within the *heart*, according to M. Bouillaud,

from any of the following sources*:—1st, narrowing of the orifices. 2d, smallness of the aortic orifice, even when the valves are perfectly healthy. This condition, whether congenital or acquired, coexists very often with dilatation and hypertrophy of the left ventricle,—circumstances which will necessarily add much to the intensity of the sound; also a similar condition of the pulmonary orifices, but this is much more rare. 3d. Vegetations and calcareous incrustations in the valves, with irregularity of their surface, even when their efficiency has not been altogether destroyed thereby, nor the size of the orifices notably affected. 4th. Infiltration of the valves and deposition of fibrinous matter or coagulable lymph on them, in inflammation of the interior of the heart.† 5. Polypous concretions formed during life, occurring chiefly in the disease just named. 6th. Præternatural adhesions of the auriculo-ventricular valves to the adjacent parietes of the heart. 7th. Dilatation of one or more of the orifices of the heart, with consequent inefficiency of the valves. 8th. Hypertrophy with dilatation of the ventricles, even though unattended by narrowing of the orifices; but here the bellows-sound is generally intermittent, and only well marked at such times as the motions of the heart are unusually accelerated. 9th. A chlorotic or nervous condition, the peculiar sound in question occurring during the presence of palpitations. 10th. Great and sudden debility from hæmorrhage and other lowering causes. Dr. Hope, in a series of experiments performed in conjunction with Dr. M. Hall, ascertained that the bellows-murmur, in conjunction with a rapid small pulse, can be produced at pleasure in the lower animals by repeated abstractions of blood; and it has here been supposed to depend on a narrowing of the cavities and orifices, which thus endeavour to adapt themselves to the diminished quantity of fluid circulating through them, and consequently no longer bear a due proportion to the great vessels springing from them; and it has also been in part ascribed to the unnatural tenuity of the blood‡, and to what is probably the most indispensable condition of all—the increased rapidity of its current caused by the spasmodic vehemence of the heart's contractions; for, that a tendency to spasmodic action in all muscular parts is an ordinary consequence of extreme depletion, is incontestable. Laennec, as is well known, supposed all these sounds, in every case, whether in the heart or arteries, to originate not in organic lesion, but in simple spasm. This was, however, to take quite too limited a view of their nature. It seems impossible to conceive that the various sounds occasionally taking place in the heart and arteries should ever have been attributed to any thing but a determinate physical cause, however difficult it might be in particular instances to ascertain its precise nature. Laennec,

* Much of what is here said on the sounds and motions of the heart is taken, with little alteration, from the article alluded to above. Dr. Copland, too, in his valuable Dictionary, appears to have drawn largely and almost literally from the same source; in one instance even an error of the press has been inadvertently retained. In alluding to this subject we do not mean, in the slightest degree, to censure the learned author for availing himself of every means of facilitating and accelerating the progress of his laborious and admirably executed undertaking; but mention it merely in order to establish at least an equal right on our part to make use of the products of our own previous labour.

† The bellows sound is a very frequent accompaniment of pericarditis also, and has generally been ascribed to the mere increase of action in the ventricles; but Dr. Hope, M. Bouillaud, and others, have shown that it really depends, in such cases, on the coexistence of inflammation of the internal lining of the heart, and the morbid changes in the valves and orifices just mentioned. The "bruit de frottement," or rubbing sound, afterwards to be spoken of, which depends on coagulable lymph effused on the surface of the pericardium, might also, by the incautious, be mistaken for the "bruit de soufflet."

‡ This thinness of the blood seems to be a very important element in the production of inorganic murmurs. Thus it is almost solely in anæmic and chlorotic individuals, that the venous murmur already alluded to occurs. The tone and accidental degree of tension of the parietes of the vessels, and the state of the nervous system, appear also to have a great influence in their production.

It is a remarkable fact, pointed out some years ago by Dr. Elliotson, that it is invariably during the ventricular *systole* that such cardiac murmurs as are independent of organic disease occur; for in the diastole no regurgitation can take place through the healthy semilunar valves, and the *onward* current setting in through the auricular valves is too feeble for the production of sound. Dr. Hope's experience not only confirms this fact, but leads him still further to limit the occurrence of murmurs of this species to the aortic orifice. On the latter point, however, he is at variance with some other observers.

indeed, has been taunted with referring them merely to "a peculiar modification of the innervation," but his context shows plainly that this was considered only a link in the chain of causation; the immediate condition necessary for their production being obviously a contracted or otherwise obstructed or altered state of the parts concerned, which, from the frequently intermittent nature of the phenomena, he supposed ordinarily, as just mentioned, to be the result of spasm, or of a vibratory or intermittent action, such as produces the "bruit musculaire" already alluded to.

In nearly all the cases enumerated above, an increase of friction in respect either to the onward or refluent current, originating in disproportionate size, irregularity of form, roughness or obstructing substances in the orifices of the heart or in the vessels, is probably the chief source of the phenomenon in question; its proximate cause consisting in a tremulous motion in the solid parietes of these parts, and a rippling eddying flow in the fluid within them: such at least are the principal conditions requisite for the production of sound in other hollow sonorous bodies.

It might appear at first sight very difficult, if not impossible to ascertain, by means of these abnormal sounds which of the orifices of the heart, if any of them, is diseased; for though the murmur may be coincident with the ventricular contraction, it may depend either on the rush of blood through a diseased aortic or pulmonary orifice, or on reflux through the auriculo-ventricular openings, or both; and if on the other hand it coexists with the diastole of the ventricle, it may originate either in reflux through the former openings, or depend on a morbid alteration of the latter, or in both conjointly.* Attention to the situation in which the murmur appears loudest or nearest, and its relation to the pulse, will however commonly greatly aid us in forming a diagnosis Thus, if it be most intense over the apex and middle of the ventricles, we may conclude that it originates in one of the auriculo-ventricular orifices (generally that of the left side), and that it is caused by the *entry* of blood if it anticipate the pulse, or by the *reflux* if it coincide with the same. Again, if the maximum intensity of the sound be higher up, as in the upper half of the sternum, *i. e.* in the region corresponding to the sigmoid valves and commencement of the great vessels, we may gather that the obstruction exists in the orifice of one of the great arterial trunks, most probably the aorta and almost certainly so if it be loudest to the right of the mesial line, — depending, if coincident with the first sound of the heart, on the onward wave of blood; if with the second, on the reflux; and if continuous, on both.† The history of the case, the investigation of the general and local symptoms, their degree of intensity, permanence, or variability must never be overlooked in our endeavours to ascertain its seat and nature. But to this subject we shall have occasion to recur when we come to treat of endocarditis and its organic consequences, valvular disease, narrowing of the apertures of the heart, as well as of the functional disorders of the organ.

A bellows sound is sometimes produced by the action of an enlarged heart against the portion of lung interposed between it and the walls of the chest, as has been noticed by Laennec, Hope, Law, and others. It has been suggested, by a recent anonymous writer in the *British and Foreign Review*, that the seat of compression in such cases may be "one or more of the larger bronchi, and that, when considerable, the impediment to the entrance of air into the corresponding portions of the lung is sufficient to produce a succession of interrupted rushings of that fluid during the efforts of respiration, which are not

* These difficulties have been recently greatly diminished by the labours of Dr. J. C. B. Williams, and also by those of Dr. Hope, detailed in the last edition of his "Treatise on the Heart."

† It is highly probable, as suggested by Dr. Williams, that the intermitting regurgitant murmur in the heart, occurring more especially in nervous patients and young females, may be occasionally connected with irregular action of one or more of the columnæ carneæ; in consequence of which, some of the tendinous chords passing into the auriculo-ventricular valves are not drawn upon exactly in the same degree with their fellows, a chink admitting of refluence of the blood being the necessary consequence.

to be distinguished as sounds from those depending on the heart itself," till we cause the patient to hold his breath, when it immediately disappears, and the true nature of the case becomes apparent. "Its existence on the right side or the left, its affecting the upper or lower lobes of one or both lungs, may assist our conclusions as to which side of the heart is principally affected. Interrupted respiration, voice, and cough are necessarily propagated in the lobe where the ramifications of the compressed bronchi terminate; and diminished respiration, with accumulated bronchial secretion, are among some of its secondary effects."*

A *thrilling vibratory sensation* is sometimes imparted to the hand when firmly applied to the præcordial region. To this phenomenon, first noticed by Corvisart, and by him supposed diagnostic of narrowing of the aortic orifice, Laennec gave the title of "fremissement cataire," or *purring tremor*, from its similarity to what we feel on touching the back of a cat in the act of purring. A sensation of the same kind is experienced on touching various bodies in strong vibration, as the outside case of an organ, for example, while the instrument is played upon; or the larynx of a person who is singing or speaking loud; or an aneurismal varix. It is very analogous to the sensation occasionally produced by the friction of the opposing surfaces of the pleuræ when rendered rough by concrete lymph, or to that felt in some cases of emphysema of the lung.

A similar thrill often exists in the arteries also, sometimes simultaneously with that in the heart, but occasionally quite independent of it. In both it seems to originate in augmented friction, caused in the one case by contraction or obstruction in the orifices of the heart, and in the other by a partial or local diminution of caliber or impediment in some of the arterial tubes. In both instances it is commonly accompanied by the bellows-murmur, generally of a grating character, and acknowledging an identical origin. Ossification of the valves, especially of the left side of the heart, and of the fibrous rings from which they spring, is a very frequent, though by no means the invariable, cause of this jarring sensation. Laennec, though well aware of its frequent coexistence with organic lesion, yet as he observed that the connection was not invariable, conceived that its immediate source must be of a spasmodic nature; and even Bouillaud admits that in many instances no permanent cause of narrowing is demonstrable, and confesses that we have not yet attained to a satisfactory knowledge of all its possible causes. One, however, in addition to those above mentioned, about which there can be no doubt, consists in friction of the opposed surfaces of the pericardium when coated with an irregular layer of lymph, as in a certain stage of pericarditis; and here the thrilling tremor is accompanied by a grating or rustling sound (the "bruit de frottement," *rubbing* or *to-and-fro sound*, synchronous with the actions of the heart); and sometimes by a *creaking sound*, which has been well compared by Collin to that produced by new leather in a shoe or saddle, and is obviously connected with a certain degree of firmness and tenacity in the false membranes lining the inflamed surfaces. A rough ossific deposit projecting on the outer surface of the heart has likewise been known to give rise both to the tremulous feel, and to a harsh scraping sound. The pericardial "bruit de frottement" is distinguishable from a similar phenomenon taking place on the surface of the lungs in pleurisy and emphysema, by being synchronous with the motions of the heart: it is generally strongest in the systole, and may be discriminated from diseased valvular sounds by being diffused over a larger surface.

* The mechanical influence of the heart or great vessels on the lungs, in the healthy state, is exemplified in the phenomenon described by Dr. Mollison under the title of "the pulmonic pulse," which consists in the expulsion of a certain quantity of air from the chest synchronously with each contraction of the heart, as ascertained by introducing a bent glass tube into the nostril, and observing that, even while respiration is suspended, the fluid in the curve of the tube moves backwards and forwards near a third of an inch with each beat of the pulse. He ascribes it to the compression of the bronchial ramifications by the diastole of the pulmonary arteries which run alongside of them.

Disordered Motions of the Heart.

The heart is liable to various irregularities in its action; amongst these are to be reckoned double or triple impulse, depending generally on spasmodic and partial contraction of the ventricles, and perhaps occasionally also, though rarely, on the diastole of these same cavities, when morbidly dilated (back stroke of Dr. Hope), or, more rarely still, on the transmission of the auricular action.* It is subject likewise to intermittence; to inequality in the strength of successive beats; to diminished energy, under the influence of lowering causes both moral and physical, obstructed pulmonary circulation, over-distension, and thinning or softening of the organ itself; and, on the other hand, to sudden or gradual and great increase in the force and frequency of the pulsations, which may be so violent and tumultuous as to give a disagreeable impulse to the ear of the observer, shaking the whole frame of the patient, and even the bed on which he lies, and being attended with a distressing internal consciousness of their presence. The more permanent these and other deviations from the natural condition may be, the more gradual in their supervention, and the more independent of extraneous exciting causes, the greater room is there to apprehend that they originate in organic disease of the heart. The power of diagnosticating morbid states of the heart's sounds and motions, necessarily implies a correct acquaintance with their natural states, and with the degrees of variation in different individuals, consistent with health; for the loudness of the former, and the extent and energy of the latter, are susceptible of various shades of difference within this limit.

The extent of surface over which *the shock* of the heart is felt, varies much in different morbid conditions: thus in cases of great hypertrophy and dilatation it may be perceptible over a space of five or six inches square, its force being at the same time augmented, and its action assuming a slow, heaving, irresistible character, in proportion as the former morbid condition prevails; and being, on the other hand, diminished in proportion as the dilatation is of a passive nature. In concentric hypertrophy, on the contrary, or that in which the thickening takes place at the expense of the capacity of the cavities, the extent of impulse is scarcely, if at all, greater than natural, though the shock thus circumscribed becomes very forcible and hammer-like. In cases where close adhesions have been contracted between the heart and pericardium, and between this latter and the adjacent lungs and parietes, the place and extent of impulse are, as we have already seen, less affected by posture, and the different states of the chest in expiration and inspiration, than in the natural condition. Again, when fluid exists in large quantities within the pericardium, whilst the impulse is greatly diminished, the points in which it is felt at successive moments are often very variable, the organ being no longer in any degree restrained or directed in its movements by the enveloping sac. Of extraneous circumstances, modifying the extent and situation of the heart's impulse, this is not the place to speak.

A *palpitation* is a beating of the heart disagreeably perceptible to the feelings of the patient, the pulse being commonly more rapid than in the natural state, and occasionally unequal in respect to strength and frequency. Palpitations are often not only felt, but heard also, by the sufferer, and this more especially when in the lying posture. Yet sometimes, even though the pulse may be very quick, and the palpitation greatly complained of by the patient, no increase of impulse is felt on applying the hand to the pericardium; and here, particularly if there be considerable morbid augmentation of sound, dilatation of the ventricle may be suspected. If, on the contrary, during the palpitation, the ear of the observer be thrown up very forcibly and over a much greater extent than naturally, hypertrophy is indicated, even though the pulse should be small and feeble. The stethoscopic examination, to be

* The reality of this last cause, though advocated by high authorities, is still liable to some doubt.

worthy of trust, must, however, be made neither when the circulation is temporarily excited under the influence of mental emotion, or by some extraneous cause, as unusual exertion, febrile excitement, a stimulant diet, or overloaded stomach; nor yet when the patient's strength is greatly reduced by depletion, inanition, depressing passions, or approaching dissolution, or even by the long continuance of the attack of palpitation, or of a fit of difficult breathing; as at such times the beat of the heart, even though the organ be decidedly enlarged, may yet from exhaustion scarcely be felt. When hypertrophy and dilatation coexist, the impulse and sound, and the extent in which they may be perceived, are all simultaneously increased.

To the subject of palpitations of the heart we shall afterwards recur, when it will be seen that in the great majority of instances they are of a nervous or sympathetic origin, and altogether independent of organic disease.

The *irregularity of the heart's rhythm* has regard to the relative duration of the first and second sounds, and also to the occasional recurrence of the first sound within less than the regular or equable time. Such irregularity may exist with or without palpitation; that is, as we have seen, with or without a consciousness of the heart's motions. An occasional ventricular contraction may be shorter and weaker than the adjoining ones, in consequence of which the period of silence will be longer, and the idea of intermittence erroneously suggested, the whole time of the beat or complete revolution of the heart not being really greater than usual. This was thought by Laennec to occur mostly in cases of dilatation. On the other hand, a ventricular contraction may here and there be much longer than ordinary, so that the first sound entirely obscures the second: this is met with as a permanent phenomenon chiefly in cases of considerable hypertrophy in which the systolic sound, though dull, is commonly long drawn out. Finally, there may be a premature reiteration, or a reduplication, of the ventricular contraction, by which likewise the second sound may be masked. Here, if the second wave thrown out from the heart be large enough, we shall have a dicrotous pulse, otherwise there will be an intermittence in the arterial pulse as compared with the pulse at the heart. Such cases are supposed by Bouillaud frequently to depend on narrowing of the orifices, or on valvular disease preventing the speedy filling of the ventricles, which cavities consequently contracting on an inadequate supply are immediately obliged to repeat their action in order to complete their task.

The second sound has occasionally appeared to commence, as it were, prematurely, cutting short and obscuring the first; and in some very rare instances Laennec thought he had heard the second sound twice or thrice reiterated with great rapidity.' Now though his theory of this sound, and consequently his explanation of these cases, were incorrect, yet the facts themselves, having been recorded by an observer of such acknowledged accuracy, are not lightly to be passed over or discredited. As he has added, in regard to the latter class of cases, that they occurred in every instance in connection with ventricular hypertrophy, it is possible that the sounds heard may have been but the reduplication of the first sound already alluded to. A repetition of abortive ventricular contractions might readily give rise to such a mistake as he committed in their explanation, especially when the jets of blood propelled from the heart were too inconsiderable to produce corresponding pulsations at the wrist. If reiterations of the second sound ever really take place, we see no other way of accounting for them but to suppose them to depend on the diastole of the ventricles, and that this is effected convulsively, or by a succession of partial or incomplete movements: now this would imply, obviously, either a power of active muscular expansion in these cavities, the possibility of which, though not yet satisfactorily made out, we are not prepared altogether to deny; or else a graduated or intermittent yielding of the contracted muscle to the force of elasticity.

In contrast with the various cases mentioned above, there is another class in which the natural double sound of the heart seems altogether absorbed in a

single prolonged bellows-murmur. Yet even here, sometimes, a division can be effected, as Bouillaud has remarked, and the murmur answering to the second sound made to appear distinct from that appertaining to the first, by reducing the frequency of the pulse by digitalis or other means; or occasionally by merely removing the stethoscope to some distance from the point where the blowing sound is most intense. In cases of extreme debility, however, the second sound is entirely and in all situations inaudible, as we have already seen.

Intermittence of the heart-pulse. As the term *irregularity* has regard to the *actions* of the heart in respect to their being prolonged, shortened, interfering, or anticipating; so, *intermittence* refers to an occasional prolongation of the period of repose or silence beyond the regular or equable time. Here, though the first and second sounds may retain their due relation in respect to strength and duration, the rhythm is, notwithstanding, broken through. The interruption may be equal to, superior, or less than, the ordinary period of a complete revolution of the heart. The intermittence of the pulse at the wrist is, however, no proof of intermission at the heart, as it may depend merely on an occasional feebleness of the systole, some of the ventricular contractions being performed with too little energy to make themselves perceptible in the remoter arteries. Hence the distinction into true and false intermissions. The latter, as well as the former, are very common in old people, ceasing, in some cases, on the supervention of slight illnesses, especially of an inflammatory kind; whilst in others, on the contrary, it is only under such circumstances that they make their appearance. In persons in the vigour of life, their occurrence, more especially during palpitations, was considered by Laennec almost as decisive proof of the existence of disease of the heart, and more especially of hypertrophy of the ventricles. Our own experience has not led us to acquiesce in the justness of this observation, having met with numerous instances of intermitting pulse in young persons without any reason to believe in the presence of organic disease.

The arterial pulse. Into this intricate subject we cannot afford space to enter fully, and must therefore confine ourselves to the notice of a few points of peculiar interest in regard to it.

The pulse, which is only incidentally mentioned by Hippocrates, who seems rarely to have drawn his indications from it, had its importance first duly appreciated by Herophilus. His opinion as to its practical value does not, however, appear to have been universally adopted by the ancients, for Celsus speaks very slightingly of it, as liable to so many sources of error, in respect to age, sex, idiosyncrasy, &c., as to render it of little avail as a means of distinguishing disease or directing its treatment. To Galen, who made it a subject of peculiar study, and who enlarged to an extravagant degree on its value and niceties in several express dissertations, may perhaps be traced the unmeasured confidence which has been bestowed very generally on the pulse as a ground of diagnosis, prognosis, and management of disease down to our own day. The Chinese have even outdone the nations of Europe in regard to the attention bestowed on the pulse, believing that by it we may not only detect the presence and nature of a disorder, but also decide in which of the great cavities, and on which side of the body, it is situated. Harvey's discovery of the circulation, whilst it gave no support to such extravagant pretensions, fixed the real value of this sign on a firmer basis than ever. The invention of the pulse-watch by Sir John Floyer first enabled physicians to indicate, with accuracy, the degree of frequency of the circulation.* Various futile or fan-

* The natural pulse of the adult male, in a state of health, may be stated as varying between 60 and 70 pulsations in the minute; that of the female on an average being about ten beats higher. In disease, the deviation from the healthy standard is often very remarkable: thus, M. Piorry has observed so few as 17 beats in a minute; and we have, on the other hand, distinctly counted as many as 200 beats in one stage of a case of acute hydrocephalus; and Frank a similar number in a case of inflammation of the great arteries near the heart of an adult.

ciful distinctions in the pulse were subsequently attempted to be established by Solano, Fouquet, and Bordeu, but they never seem to have attained to much credit in this country. Drs. Heberden and Falconer, two of our principal writers on the subject, fell, indeed, into the opposite extreme of confining attention almost exclusively to the frequency of the pulsations, as if this were the only circumstance respecting which we can form a determinate notion, or at least the only one as to which we can feel certain of its being appreciated exactly alike by different individuals. The investigations of Laennec have proved satisfactorily that this view is too limited; and shown, at the same time, that much valuable information may be obtained by comparing the pulse as felt at the heart with its condition in the more distant arterial branches. The attempted distinctions of Stahl between the quick or short and the frequent pulse, and between the slow or prolonged and the rare pulse, are now known to be well founded, though opposed originally by the high authority of Hoffmann. The frequency and rareness of the pulse depend on the number of complete revolutions performed by the heart in a given time;—its quickness and slowness on the time occupied in each ventricular contraction, if we refer to the heart; but partly also on the tone of the arteries, as indicated by the degree of their yielding, and the speed with which they react on the blood injected into them, if we refer to the pulse in the remoter parts of the system.

The state of the pulsations at the heart was justly held by Laennec as constituting a better index of the degree of danger in a disease, as well as of the appropriateness of depletion, and of the length to which it may be carried, than the arterial pulse. In disease of the heart, for example, the latter may be very feeble, whilst the former by its violence justifies the use of the lancet. It was a rule with him that we may bleed fearlessly, however weak the pulse at the wrist, provided the contraction of the ventricles be energetic; whereas, if the heart's action, on the contrary, be feeble, whatever is the state of the arterial pulse we must abstain from the use of this remedy. The doctrine of the arterial and capillary action being to a considerable degree independent of that of the heart, which has latterly met with many able advocates, was the fixed creed of Laennec, who thought it was in a manner proved by the very different effects of venous, arterial, and capillary depletions. The insulated occurrence of the bellows-murmur and purring thrill in arteries was likewise adduced amongst the evidence of this independent action.

The character of the arterial pulse depends, as Dr. Williams remarks, jointly on the mode of action of the heart, on the quantity of blood in the system, and on the state of the arteries themselves; and necessarily varies with changes in each of these elements. (*Med. Gaz.*) The number of pulsations at the wrist can obviously never exceed that at the heart, but may, as we have seen, sometimes fall much short thereof, viz. where some of the ventricular contractions are so weak and incomplete that the impulse given by them to the blood is lost long before reaching the more distant arteries. Again, when the action of the heart is greatly reduced, as in the state of syncope, the radial pulse may, for a time, be even entirely extinct. In violent palpitations, moreover, the arterial pulse may be quite feeble, and indicate that the action of the heart, though so vehement and tumultuous, is really inefficient. Hence the obvious importance of exploring the pulse simultaneously in the two situations indicated, in order to obtain a correct idea of the real state of the circulation as a whole.

That the character of the pulse is in a conspicuous degree dependent on the mode of action of the central organ of the circulation we have proof in its becoming sharp when the contractions of the heart are abrupt, as happens especially in states of nervous irritation, or in febrile conditions when complicated therewith.

We have read moreover of instances where a still greater number of pulsations was noted within the same space of time. Dr. Graves speaks of the singular case of a lady, whose pulse, which was only 38 in a minute, did not become accelerated during febrile illnesses.

In active inflammation it commonly possesses, in addition to sharpness, a marked degree of strength. Organic affections of the heart are, as we should expect, peculiarly capable of influencing the pulse. Active enlargement of the organ, when unaccompanied by any very great obstruction of the orifices or inadequacy of the valves, generally gives rise to a full pulse, which will be hard in proportion to the tension of the coats of the arteries. If the heart, on the other hand, be dilated, and its walls thinner than natural, the pulse may be abrupt or sharp, but not strong, and is generally slow of reaching the distant arteries. Its size will vary with the state of the arteries and the quantity of blood. Inefficiency of the mitral valves, admitting of regurgitation, tends to deprive the pulse, which is in such cases generally very irregular, of part of its fulness and strength. Imperfect aortic valves, from the same cause, give a jerking or momentary character to the impression of the pulse against the finger, and at the same time render the onward motion of the arterial wave, as has been remarked by Dr. Corrigan, peculiarly visible; for the column of blood, though often expelled with great force, in consequence of the frequently coexisting hypertrophy, is yet, from the inadequacy of the valves, not sustained during the natural period, so that a portion of it almost instantly falls back into the ventricle, and thus effaces in a moment the dilated tortuosity of the vessel. In cases of narrowing of the left auriculo-ventricular orifice, the pulse is for the most part not only small, but peculiarly irregular, and it is in this form of disease that we have very often, as pointed out by Mr. Hodgson, two beats at the heart for one at the wrist; both of which circumstances are ascribable to the imperfect supply of the left ventricle with blood. Narrowing of the aortic orifice, if considerable, must necessarily diminish the force of the pulse, but, unless existing in an extreme degree, it may still be possessed of much hardness. (Williams, *loc. cit.*)

Of the influence of the quantity of blood on the pulse, we have a striking example in cases of plethora, in which it is distinguished by its fulness as well as strength, unless where, from over-distension or some other cause, the action of the heart is temporarily oppressed; and, even here, bloodletting will often immediately lead to the development of its true character. Again, loss of blood in ordinary cases renders the pulse softer and less frequent; but if carried to excess, or performed in particular states of the system, such as exist in nervous or chlorotic individuals, it seems to exalt the irritability of the heart, and consequently renders the pulse more rapid and sharper; but even then it will have a quick jerking or bounding character, without fulness or permanency under the finger, sufficiently indicative of deficiency of blood in the vessels and abrupt systole of the heart.

The state of the arteries, in respect to tone and elasticity and thickness of parietes, necessarily exercises a considerable influence on the pulse. When they are large and yielding, supposing the heart to be acting with its ordinary rigour, the pulse will be full and soft. When, on the contrary, they are contracted and tense, it must be hard and small. The tone of the arteries, or their contractility, is notably modified by temperature and hygrometricity, being augmented by a cool dry atmosphere, and diminished by the opposite conditions. Where the coats of the arteries, as in the aged, are rigid, the impulse given to the blood by the heart will be transmitted with little modification; whereas if the arteries are thin, elastic, and imperfectly distended, they must tend to reduce its hardness and force, and retard its progress, and, if any of the pulsations be particularly weak, to obliterate them altogether. In inflammatory conditions of the system, in consequence of the increased tension of the arteries, the pulse in the extremities is almost synchronous with that in the heart; whilst in debilitated states, on the contrary, in which the vessels participate, the transmission through the relaxed arterial tubes is much slower, and consequently the interval between the pulse in the two situations just indicated is remarkably augmented. The state of the capillary circulation is likewise to be taken into account amongst the circumstances capable of modifying the arterial pulse. An artery

running to an inflamed part throbs with unusual vehemence, and seems to participate with its ultimate ramifications in a state of exalted action. The condition of the veins and capillaries often, moreover, throws much light on the state of the general and pulmonary circulation, and should always be carefully investigated. A swollen state of the venous trunks, and pulsation in the jugular, frequently point unequivocally to over-distension of the right side of the heart, and imperfect action of the tricuspid valves; whilst a general overloading of the capillaries with arterial or with venous blood, which displays itself so peculiarly in the cheeks, conjunctiva, lips, and extremities, is likewise indicative of various states or stages of deranged or obstructed circulation, and remarkably characteristic of disease of the organs within the chest, and most particularly so of organic affections of the heart.

The condition of the lungs, placed as they are between the right and left sides of the heart, very materially influences the pulse. The numerical relation between the pulse and the number of respirations in a given time may be stated in the healthy condition to be about as $4\frac{1}{2}$ to 1. Dr. Hooker, in an interesting communication in a recent number of the *Boston Medical and Surgical Journal*, says that this is so universally true, that any great deviation from it may be looked upon as evidence of malformation or disease, provided there be no mechanical impediment within or without the body to the descent of the diaphragm. Where the rate of the respiration to the pulse is notably increased, it generally indicates some impediment to the aëration of the blood, either from disorder in the air passages or lungs (pneumonia, œdema of the lungs, incipient phthisis, &c.), mechanical impediment, or imperfect function of the organic nerves of the lung. In typhus and delirium tremens, on the contrary, the relative frequency of the respiration is remarkably diminished, which may be ascribed to the disordered condition of the brain and spinal cord, and impaired function of the motor respiratory nerves. The relation of the breathing to the pulse has also engaged the attention of Dr. Macdonnell, of Belfast, for many years; but it is to be regretted that the result of his investigations, which were carried on on a very extended scale, have not yet been communicated to the public in a complete form. Some notice of them is to be met with in the reports of the medical section of the British Association for the year 1835.

The obstruction of the lungs, as in severe and very extensive cases of pneumonia and bronchitis, and of profuse pleuritic effusion, necessarily causes an overloading of the right cavities; whilst those of the left side are inadequately supplied with an imperfectly arterialised blood, and consequently contract for the most part with diminished energy; under these circumstances the pulse, notwithstanding the presence of inflammation, will be comparatively soft and feeble, though it may occasionally have a certain degree of abruptness or sharpness about it which might by the inexperienced be mistaken for strength. It is accordingly a very general rule, that when the respiration is profoundly impaired the pulse soon loses its body and strength (*Williams*). There is a peculiar state of the pulse, mentioned by Laennec, in which it remains for some time tense and full under the finger, and which seems, occasionally at least, to be produced by obstruction of the pulmonary circulation, for it is felt in a very marked manner during a fit of coughing, and may possibly also be sometimes caused by a spasmodic continuance of the ventricular systole leading to an overloaded condition of the auricles, and consequently to momentary obstruction in the capillaries, and an interruption to the onward movement of the arterial current.

To prepare us for forming a just estimate of what constitutes in any given case a morbid condition of the pulse, we must be aware of the varieties to be found in the natural state, — varieties dependent partly on the strength of the heart, and partly on the natural constitution of the arteries. Thus, persons in whom the arteries have thin and yielding coats, and are at the same time of large diameter, will (the action of the heart being moderate) ordinarily have a soft large pulse: if their caliber be small, as is frequently the case in females,

the pulse will be small and weak; if the walls, on the other hand, be deficient in elasticity and very firm, as in the aged, the pulse will then commonly be hard and strong, as well in health as in disease, — a circumstance which often takes greatly from the value of this sign as indicative of inflammatory action, or particular diseases of the heart, in advanced life.

The pulse is influenced not only by disease, temperature, age, sex, temperament, and idiosyncrasy, but also, and very remarkably, by moral emotions, by diet, by the recent taking of food or other stimuli, by inanition, by narcotics, by exercise, posture, sleep, and watching, and the period of the day, &c. Gravitation manifests a decided influence on the pulse; thus, for instance, as M. Piorry remarks, if a limb be raised into a vertical position, the beat of the artery becomes considerably feebler. Bryan Robinson, in his treatise on the Animal Economy, shows himself to have been fully aware of the effect of gravity on the motion of the blood in the vessels. The influence of exercise in raising the pulse exceeds greatly that of all other stimuli, and even of the most inflammatory fevers. (*Knox.*) A full meal will augment the frequency of the pulsations of the heart by from ten to twenty beats in the minute, according to the excitability of the individual. The ordinary ratio of the pulse to the respiration in healthy adults is, as we have seen, as a little more than four to one; and variations in this relation afford valuable indications in disease.* The frequency of both functions is considerably reduced during sleep, which seems to depend chiefly on the comparative cessation of all voluntary muscular action.

The *effects of posture* on the pulse, for the knowledge of which we are indebted originally to Dr. Bryan Robinson in the work already alluded to, and more recently to the investigations of Drs. Macdonnell, Falconer, Knox, Graves, Nick, Mohl, Guy, &c., are very remarkable. The pulse is, for the most part, considerably more frequent in the erect or standing than in the sitting posture; and in this latter, again, somewhat quicker than when lying; the average difference in the first instance being about double of that in the second. Thus, in Dr. Guy's experiments, after the deduction of all exceptional cases, the average difference between the standing and sitting posture, the heart beating moderately, was about ten pulsations; between sitting and lying, about five; and between standing and lying, about fifteen. The difference depends on, and is directly proportional to, the muscular effort exerted in the maintenance of the respective postures. It becomes greatly augmented in cases of debility and fever; and increases in a very rapid ratio whenever the circulation, whether from disease or exercise, is much accelerated. It is, moreover, according to Dr. Knox, most conspicuous in the earlier parts of the day, reaching its maximum about noon, and its minimum towards midnight. The excitability of the pulse in respect to other causes is likewise, when in a state of health, at its height in the morning. Every one of susceptible nerves must have observed how very small a quantity of wine or animal food is sufficient to overheat and flush him at that time of day.

The strength of the pulse is greatest in the recumbent posture, so that the greatest strength and least frequency are attained simultaneously. Inverting the body, as Dr. Graves remarks, renders the pulse occasionally irregular, and weaker than when in the horizontal posture; but he did not find it further to retard it. On this latter point, however, his observations are at variance with those very recently made by Dr. Guy, in which the pulse fell on an average three beats (and in particular cases much more than this), on the body being sustained in a vertical position by means of a revolving board to which it was strapped. The writer last named has further noticed that the influence of

* Dr. Graves once met with a case of fever in which, though the pulse was but 60, the respirations were 50, in the minute; in another case, the pulse being 84, the respirations were 42; in a third, the pulse being 120, the respirations were no more than 12: and he has made the general remark, that where the respirations are very numerous (40, for example), with a comparatively low pulse (80 to 90), a fatal result may generally be anticipated.

posture is somewhat greater in the male than in the female; and in adult age than at a more youthful period.

To all the above rules, as to the effect of position, there occur many exceptions the causes of which have not as yet been fully explained. In some cases of disease of the organs within the chest, where the recumbent posture still further embarrasses their action, we should expect to find them often infringed upon, or even reversed: so likewise, sometimes, where tumors or effusions within the abdomen are brought to gravitate more than usual on the thoracic contents. In advanced cases of hypertrophy and dilatation of the heart, Dr. Graves has found the pulse very generally unaffected by posture; and he suggests that where this exemption exists it might perhaps be ascribable to the increased power of the muscle placing it beyond the influence of the ordinary causes of excitement, which, as we have seen, are most conspicuous in weaker conditions: and thus we attain to another criterion by which to distinguish organic from functional disease of the heart.*

Mr. Gorham's tables of the pulse in infancy and childhood show, in conformity with the results attained by Dr. Guy, that the effect of posture is much less conspicuous in young subjects than at a more advanced period. In infants in arms, who in every posture are chiefly dependent on external support, and make comparatively little muscular exertion to maintain their position, this is just what we should expect. In childhood, again, the mass of the heart bears a much greater proportion to that of the whole body than at a later age, and may therefore be supposed more independent of the influence of slight modifying causes, and better adapted by nature for the restless movement and constant change of posture characteristic of that age. Mr. Gorham's observations demonstrate the curious fact that the mean pulse of the new-born infant is considerably less than that of a child some weeks or months old; the average pulse during the first week being about 128; that between the first and fifth month about 148; from the fifth month to two years old, which includes the period of dentition, the pulse still keeps high, the mean being about 130; that from the second to the fourth year about 112, and from thence to the tenth about 107. The maxima and minima are, however, often very remote indeed from the mean results: thus, during the first week of infancy, out of forty-two observations, the maximum was 160, and the minimum so low as 96. The mean numbers are throughout much higher than the corresponding ones given by Heberden; but as the latter author does not mention the number of cases from which his averages were deduced, and seems even to have overlooked the fact of the rise of the pulse subsequent to birth, his results appear less entitled to credit than those of Mr. Gorham. The subject is still, however, open to further investigation.

Venous pulse. It has recently been asserted by Mr. King (*Guy's Hospital Reports*) that by means of a sphygmometer, consisting of a fine capillary index, made by drawing out a piece of sealing-wax into a thread, and affixed by a little tallow across a superficial vein, so that about nine tenths of its length may project on one side of the vessel, the phenomenon of a venous pulse may in all cases be rendered obvious to the sight; but most satisfactorily so when repletion of the sanguineous system exists. The attempt to verify this observation has, however, to our knowledge, totally failed in other and very careful hands; so that it appears still very doubtful whether, in the natural condition, there is any appreciable pulsation in these vessels, save such as may occasionally be communicated to them by an immediately subjacent artery. Yet, in certain morbid states of the circulation, an independent venous pulse has unquestionably been observed; though, with the exception of the throbbing of the jugulars in disease of the right side of the heart, already alluded to, it has not yet been made out distinctly what is the precise morbid condition of the circulatory system with which it is more peculiarly associated. The cases, however, in which it has

* Dr. Graves's latest investigations on this subject led him to consider the law of exemption, under such circumstances, universal.

chiefly occurred have generally been those in which there was præternatural vehemence of the heart's action, either connected with disease in this organ itself, obstruction of the pulmonary circulation, violent inflammation in some important viscus, or, finally, with the irritative reaction ensuing upon excessive depletions; — and it has been variously ascribed to overaction of the left ventricle, and the forcible transmission of the wave-like motion of the blood through the capillary system; to regurgitation from the right ventricle, and a retrograde impulse communicated through the substance of the valves of the tensely distended veins; and, lastly, to an independent action in these vessels themselves. It has most frequently been noticed in the upper extremities, and generally in females.

In the instance recorded by Hombert (*Mém. de l'Acad. des Sciences*, Paris, 1704), the venous pulsation, which is stated not to have been synchronous with the action of the arteries, occurred in the paroxysms of asthma, in a case of passive dilatation of all the cavities of the heart, and was supposed to depend on regurgitation taking place during the existence of violent palpitation. Dr. Davis met with the same phenomenon in a patient, in whom dissection is said to have discovered nothing but a slight degree of hypertrophy of the left ventricle (*Dub. Hosp. Rep.* vol. iv.). Dr. Elliotson, in a note to Blumenbach's Physiology, speaks of having seen the veins on the back of the arm and forearm pulsate in unison with the arteries, in a young female labouring under a chronic catarrh, in which the paroxysms of coughing were very violent. The same appearance has been noticed by Dr. Ward, in the same situation, in a woman who was much debilitated by a miscarriage, and subsequently by large depletions on account of an incipient pneumonia; and he supposed the pulsation in question to have depended "on excessive reaction of the heart, pushing the thin and impoverished blood through the capillary system straight on into the veins." (*Lond. Med. Gaz.* June 1832). A distinct pulsation corresponding to each stroke of the left ventricle was observed by Dr. Graves in all the veins on the back of the hand in a case of pneumonia, in which the action of the heart was peculiarly vehement; and also in a female labouring under acute peritonitis. He was unable to decide whether the phenomenon originated under the direct influence of the heart, or in an independent action in the coats of the veins themselves. (*Ibid.* Jan. 1831; and also in *Dub. Med. Journ.*, Sept. 1834.)

A more detailed account of a case of the same kind, which appears to have been examined with great care both during life and after death, is given by Mr. Benson in the *Dublin Medical Journal* for November, 1835, to whose able paper on the subject we are indebted for most of the above facts. The patient who had long laboured under symptoms of enlargement of the heart, was a female of intemperate habits and advanced age; and the pulsation was confined to the jugulars and to the veins of the upper extremities, which were remarkably tense and prominent; and it followed, by a minute but distinctly appreciable interval, the diastole of the radial artery. Though the arterial pulse was very feeble, that in the veins was quite obvious to the sight; and some individuals, who examined the patient, thought they could also feel it. It was ascertained that the valves of the veins acted perfectly, and that the pulsation was interrupted when pressure was made on the brachial artery; and also that it disappeared temporarily after practising depletion. On dissection, the heart was found of double the natural size, chiefly owing to the greatly dilated and hypertrophic condition of the right ventricle; the orifice of communication with the auricle was much enlarged, and the corresponding valve in part cartilaginous. The mitral and aortic valves were encrusted with calcareous matter, and the left passages thus very considerably narrowed; whilst the ventricle of this side, though enlarged, was apparently not increased in power, its walls being pale and soft. Nothing peculiar could be detected in the vessels of the arm, and there was certainly no unnatural dilatation of the capillaries, as it was attempted in vain to force a fine injection from the arteries into the veins. Mr. Benson ascribes the unusual pulsation in this case, with much probability, to

regurgitations from the right ventricle, a retrograde shock being thus communicated to the column of fluid in the distended veins, by the very violence with which their valves were thrown up; whilst the circumstance of its succeeding, by an appreciable interval, the pulse in the arteries, is attributed to the more yielding nature of the structure of the former vessels. The obstructed condition of the orifices of the left side of the heart, and the consequent weakness of the pulse, certainly render it unlikely that the venous pulsation should have been continued through the capillary system; whilst the influence of pressure on the great artery of the limb, already noticed, may have depended on the diminished tension of all the veins so caused, and the consequent neutralisation of the reflex impulse.

General Observations on Diseases of the Heart.

The term "disease of the heart" stood in times past, with many members of the medical profession, as it does still with the public, for an uniform and general affection of this organ, of an utterly intractable and necessarily fatal nature. More accurate investigation into the symptoms and progress, and still more into the morbid changes of structure, presenting themselves in the individual cases passing under this title, has eventually proved how erroneous is the above conception in all its parts. Disease of the whole heart is scarcely ever met with. As there enter into the composition of this organ examples of most of the tissues which are to be found within the body, and as its mechanism is of a complicated nature, it offers, like other parts of high and varied organisation and energetic action, many points for the origination of disease. This generally manifests itself first within the limits of a single tissue, more commonly the inner or outer lining of the organ, or its muscular walls; and even when it comes at length to alter the size and form of the organ, the relations of its cavities, the orifices of communication and the valves which surround them, these parts are still found to be affected in very different degrees. The right and the left sides, too, are very rarely compromised to the same extent, and even the two cavities of the same side scarcely ever suffer equally.

Some of the most violent, painful, and, if unchecked, often most rapidly fatal, diseases of the heart are, as we shall afterwards see, of an inflammatory nature. These, when neglected or imperfectly subdued, if not fatal in their earlier periods, generally give rise to such organic changes as are comparatively little within any other than the palliative influences of medicine. Some of its affections, again, often apparently originating in a very chronic species of inflammation, come on insidiously from the first in the form of a gradual deposition of morbid matter, generally of a cartilaginous or osseous nature, occupying more especially the apertures of communication, and the most moveable and delicate portions of the interior mechanism, which, by throwing obstruction in the way of the blood, and compelling the organ to increased exertion, lead to morbid development of the muscular tissue, to distension of its cavities, or more frequently to both. In other instances, similar changes of dimensions seem to ensue merely upon excessive action and consequent over-nutrition of the organ, often evidently the result of habitual undue excitement of a moral or physical nature. An opposite class of cases, of rarer occurrence, are characterised by a wasting away or softening of the heart, a loss of size and power, which seem for the most part to have their source in general or constitutional causes. In a very large number of instances, again, the deranged action is happily merely of a functional nature, depending on a peculiar condition of the nerves of the organ, or that of the system at large; or, it may be, on the reaction of some of the other viscera; and it is here, under favourable circumstances and judicious management, for the most part susceptible of great alleviation or complete removal.

From these general views, the importance of accurately discriminating the various disorders to which the heart is liable will, we trust, sufficiently appear.

The means by which their diagnosis from each other, as well as from diseases of other organs, is to be attempted, are of two kinds. 1st, the local or physical signs; and 2d, the general symptoms. The local signs fall under the cognisance of one or other of the three senses of sight, touch, and hearing, and more especially of the two last. By accurately inspecting the præcordial region, we may become acquainted with enlargements and changes of form in this part of the chest, depending on considerable effusion into the pericardium, or great augmentation in the size of the heart; and are likewise sometimes made aware of the existence of vehement cardiac action, by the visible heaving of the corresponding parietes, and the shaking of the vestments, at every pulsation. A dimpling or depression of the epigastrium, coincident with the contraction of the heart, has been asserted to be sometimes obvious to the eye, and has been reckoned amongst the occasional, though rarer, signs of a closely adherent pericardium.

By the touch we learn whether the impulse of the heart takes place in the natural situation, or whether it is felt in a different point, or over a larger surface, than usual; whether it is increased in frequency, force, or duration; whether it is accompanied by a jarring or thrilling sensation; and finally whether there is any bulging or unnatural increase of width in the intercostal spaces. By the employment of pressure between the ribs, or in the epigastrium in an upward direction towards the tendinous part of the diaphragm, to which, as we have seen, the pericardium is attached, and on which the heart lies, we become cognisant of any unnatural tenderness either in this membrane, or in the important organ which it protects, both of which are, in the natural condition, nearly insensible, as was proved by Harvey's celebrated case where the heart was exposed to the touch.

By auscultation we ascertain whether the normal sounds accompanying the heart's action have undergone any of those changes, in respect to their character, place, or intensity, which have been already spoken of, and so obtain valuable knowledge as to the state of its walls and cavities, orifices, valves, and great vessels: whilst the sounds artificially elicited by percussion make known to us the presence of effusions into the pericardium, tumors and aneurisms in the same situation, or its immediate neighbourhood; as likewise the existence of inordinate congestion and enlargement of the heart.

The anxious, protruding, watery eye, the fulness of the under lid, the morbidly pale, leaden, or purplish hue of the complexion, give a peculiar and often very striking *physiognomy* to patients labouring under disease of the heart in its more advanced periods.

The *general signs* or symptoms of its diseases are necessarily numerous and complicated, inasmuch as in the derangement of its function, viz. the due circulation of the blood to all parts of the body, every organ is more or less implicated. In this respect nearly all its serious lesions coincide; but, as we investigate more closely the groups of symptoms to which each variety of disease individually gives rise, we shall find in them very considerable shades of difference, according to the part of the organ affected, the stage or degree of the structural change and its precise nature. Thus, where the inner or outer covering is inflamed, there will commonly exist, as in the case of inflammation of similar membranes in other parts of the body, acute pain and fever, exasperated more particularly in this instance by the impossibility of placing the suffering organ in a state of permanent repose; — together with alarming nervous symptoms, originating in part in the sympathy of the brain with the important viscus engaged, as well as in occasional disorder in the sanguineous supply of the cerebral system.

Increased size and power of the left ventricle will prove the source of frequent active determinations of blood, especially towards the head, as indicated by the florid or flushed condition of the face, the brightness of the eyes, and animated expression of the whole countenance, and irascibility of temper; whilst there is besides, in such cases, often a sense of dizziness and confusion,

especially in stooping, occasional profuse bleeding from the nose, and a marked tendency to cerebral hæmorrhage.

In the rarer instance of a similar condition of the right ventricle, the lungs suffer more particularly, or at least earlier in the course of the disease, as is evinced by the frequent occurrence of hæmoptysis, pulmonary apoplexy, &c.

Pulmonic congestions, however, and inflammations, more especially those having their seat in the bronchial membrane, and passing under the vague title of asthmatic affections, occur, it must be confessed, sooner or later, in nearly all diseases of the heart, in whatever part of the organ they may have originated.

It is when there exists a considerable mechanical obstruction to the passage of the blood on either side of the heart, and also when the action of the organ is greatly debilitated, that the disturbance of the circulation reaches its maximum, as manifested in the extremely deranged action of the capillary system, the obstinate recurrence of venous congestions, and passive serous effusions. Where the impediment is in the left side, the lung will probably be the seat of the earliest obvious functional disturbance; whereas if it be in the right cavities, the venous system of the abdomen and head will be more apt to participate in its effects from the first: but to state this order of the occurrence of symptoms as absolutely fixed and essentially characteristic of affection of each side respectively, as has occasionally been done, would only tend to mislead, because inconsistent with actual experience. MM. Bertin and Bouillaud, without denying altogether the influence of hypertrophy, dilatation, and softening of the heart in embarrassing the circulation, obviously consider its derangements as chiefly the result of mechanical obstacle. Dr. Hope, on the contrary, thinks the former conditions even more deeply concerned in their production than the latter: and Dr. Clendinning in his recent publications takes a still lower view of the importance of mere mechanical obstruction in respect to the visceral derangements induced by cardiac disease; for it would appear by them that out of about 180 cases of hypertrophy of the heart, no less than $\frac{5}{6}$ of the whole number were instances of simple hypertrophy, being, as he assures us, quite exempt from all other pathological change in the organ; its valves, orifices, linings, &c., being found altogether in their natural condition. He adds, that cerebral apoplexy had occurred in no less than forty-two per cent. or $\frac{3}{4}$ of these cases; and that in almost every instance there was visceral disease of some kind or other, in connection with the simply enlarged heart. But he admits at the same time it is where disease of the orifices or of the valves is also present, that the most extensive dropsical effusions and the greatest pectoral distress manifest themselves. He insists, however, that the valvular disease is rather the consequence than the cause of hypertrophy, as this latter condition of the heart, itself the result of a vital and not of any mechanical condition, is known to predispose to inflammation of all parts of the body, and to that of its own inner lining membrane of course amongst the number.

On a review of the whole evidence, however, it appears to us that Dr. Clendinning decidedly underrates the influence of obstruction as an early element in the production of enlargement of the heart; and his conclusions on this point, standing as they do in opposition to those of some of the best observers of our day, require, we think, additional confirmation based on still more extensive premises.

A mode of an obviously mechanical nature, in which an enlarged heart or distended pericardium may sometimes derange the functions of an adjacent organ, is exemplified in the compression or displacement of the lung, or the flattening of some of the bronchial tubes, the latter of which consequences has recently been enlarged upon by Mr. King.

Amongst the occasional immediate consequences of disease of the heart have been enumerated, but on very insufficient evidence, a deep-seated destructive inflammation of the eye-ball, and gangrene of the limbs, to the latter of which we shall again have occasion to allude when we come to speak of hy-

pertrophy. But, of all the consequences of diseased heart, none appear to be more constant than hypertrophy of all the organs within the three great visceral cavities. By the researches of Dr. Clendinning it has been established on the firm basis of the numerical method, that not only the liver, spleen, and lungs are notably increased in weight in such cases, but that this is the case likewise in respect to the brain, stomach, intestines, kidneys, pancreas, &c. Nor does this result appear to connect itself exclusively with any one particular disease of the heart, for it is met with in cases of extreme impediment to the course of the blood, no less than in those where the existence of hypertrophy and enlargement of the cavities, along with a free state of the orifices, might be thought to give an easy account of its origin. Dr. Clendinning thinks himself justified, therefore, in concluding that the several organs are able to convert even the venous blood with which they are congested into materials for their own excessive nutrition. That their increase is caused by a real augmentation of the solid parts, and not by mere congestion of the vessels, was ascertained by making incisions into their substance, and draining off as much of their fluid contents as possible, previously to submitting them to the balance.

Enlargements of the abdominal viscera, and more especially of the liver had long been observed frequently to coexist with diseases of the heart, and were sometimes looked upon erroneously as their cause; whereas they are really for the most part but one instance of a general effect of this class of disorders. The flatulence, and other dyspeptic symptoms which so often manifest themselves in the advanced stage of cardiac affections, are, in like manner, generally the result of a secondary affection of the stomach. The kidneys, too, very commonly perform their function imperfectly, the urine being deficient in quantity, and high-coloured. But it is the respiratory system which most invariably suffers, as we might readily have anticipated from the close physiological connection of the heart and lungs. Hydrothorax, asthma, and the chronic cough of the aged, so often mistaken in former times for primary affections, have, as is now well made out, most frequently their source in disease of the heart. How often the brain also is consecutively involved, we have just seen when speaking of the frequent occurrence of apoplexy in these cases. We have known headachs, of the most intense character, recurring at frequent intervals from a very early period of life, and rendering existence scarcely endurable, to have had the same origin, though their true source, at a period when diseases of the heart were less understood, and their physical signs less sought after than at present, had generally been quite overlooked by practitioners of the first eminence, by whom they had been treated throughout as if of nervous or of dyspeptic origin; till at length the occurrence of dropsical symptoms, and other signs of cardiac disease of a kind no longer to be mistaken, rendered their real nature obvious. Generally speaking, however, the symptomatic affection of the brain in these cases is of a less acutely painful character than that just spoken of.

Causes of Diseases of the Heart.

The almost unceasing labour of the heart, its extensive sympathies, and its consequent frequent excitement by affections of distant parts, enable us in some degree to understand why it should be so frequently the subject of disease. Corvisart believed that the number of deaths caused by diseases of the heart stood next in frequency to those produced by phthisis; and the results of Dr. Clendinning's numerical investigations are quite in harmony with this opinion: they show that what phthisis is, in point of frequency and mortality, prior to the middle period of life, disease of the heart becomes subsequently. Of all the dissections which he had occasion to witness within a given period, in the institution to which he is attached (amounting to upwards of 500), about one third presented evidence of the existence of disease of the heart, and more

especially of hypertrophy; and of those so affected the males were twice as numerous as the females. Its presence is observed greatly to aggravate the danger of coexisting pulmonary, cerebral, or abdominal affections. From this circumstance, as well as from the frequency of its occurrence and its usual incurability in its advanced stages, the importance of accurately investigating its causes, in order to remove or counteract their influence, at the earliest period, is obvious. They are ordinarily divided into the predisposing, and the exciting, —a distinction which here, however, as in so many other instances, cannot be universally adhered to, without the sacrifice of truth to the spirit of system, as several of their causes partake at once of both these characters

That a hereditary tendency to heart disease exists in many individuals is unquestionable. Lancisi mentions one family in which it occurred in four successive generations; and Albertini another, in which five brothers with their sister were its victims; and numberless other instances to the same effect might, if necessary, be adduced. The rheumatic and the gouty, those who have laboured under very severe agues, persons of an irritable and of a sanguineous temperament, those of a plethoric habit, and likewise deep-chested individuals of a robust make, with an inordinate development of the muscular system, seem peculiarly prone to disease of the heart. At the head of the causes which are more immediately concerned in calling it into being, are to be placed all those favourable to the production of inflammation generally, and more especially exposure to cold and moisture; for the very same influences which give rise in one individual to a pleurisy, or a rheumatic attack, will in another be succeeded by the incursion of pericarditis or endocarditis, with all their formidable consequences. The *coincidence* also of inflammation of the lining membranes of the heart with pleurisy and pneumonia, and still more with acute rheumatism of the extremities, is matter of daily observation; and instances of the metastasis of the latter affection, and of gout to the heart, abound. The repulsion of the exanthemata, and the mismanagement of the advanced stage of scarlatina, more particularly, are occasionally followed by inflammation of the serous covering of the heart, as well as of other similar tissues in other parts of the body. External injuries, as violent blows, or long-continued pressure on the præcordial region, and wounds, are also amongst the occasional causes of diseases of the heart. Amongst their sources is also to be enumerated whatever produces frequent overaction of the organ, the abuse of stimulants, long-continued fatigue, loss of rest, sexual excesses, and a plethoric state, which is often connected with the suppression of some habitual evacuation, and with the hæmorrhoidal or menstrual fluxes more particularly.

Violent muscular efforts, also, and whatever materially embarrasses the pulmonary circulation, as the playing on certain wind instruments which require a great exertion of breath, and, finally, whatever makes excessive demands on the propulsive power of the heart, are to be placed in the same category. Although the disorder immediately ensuing upon exposure to such circumstances be at first only functional, all analogy leads us to expect, where they are habitually renewed, that structural change, if there exist any predisposition this way, should be their ultimate result.

Obstruction of the circulation, whether seated in the heart itself or in the great vessels, must necessarily, from the mutual connection and dependence of the several parts of the system to which they belong, tend to produce additional disturbance and disease, enlargement of the cavities of the heart, hypertrophy of its walls, &c. The frequency of the coincidence of aneurism of the aorta with hypertrophy and dilatation of the heart has long attracted attention. An original disproportion of strength between the heart and the aorta is placed by Corvisart amongst the occasional causes of disease in either situation. Obstructions within the lung, as in chronic pneumonia, or bronchitis and asthma, are looked upon by the same author as not unfrequent sources of heart disease.

That they should be quite uninfluential in regard to it, is certainly altogether improbable; but in a very great majority of instances, it is much more likely that they are its effect than its cause, though, in their turn, they cannot fail to react injuriously on it.

As to the influence of the moral emotions, we are satisfied, notwithstanding the scepticism of M. Bouillaud, that Corvisart, Schina, and the great majority of writers who side with them, are quite justified in laying great stress on them as occasional causes not only of the nervous, but also of the organic affections of the heart, as the greater prevalence of these disorders after periods of vehement civil commotion (as was remarkably the case after the French revolution) sufficiently testify.

As to the asserted agency of the syphilitic or other virus in inducing morbid vegetations of the valves, no adequate proof, that we are aware of, has ever yet been adduced.

Derangement of the general health, induced by errors in diet, anxiety of mind, and neglect of air and exercise, will tend to accelerate the development of diseases of the heart no less than those of other organs.

Prognosis in diseases of the heart. Diseases of the heart are no longer considered of so uniformly hopeless a character as we find ascribed to them in the pages of the older writers, and even of Sénac and of Corvisart. An improved diagnosis, and a more correct knowledge of the varieties of these affections, enable the practitioner of the present day to discover them earlier, and treat more appropriately and vigorously than his predecessors such as are still within the reach of art.

In the merely nervous and symptomatic affections, the prognosis is generally favourable, especially where no marked debility has yet supervened, and where the derangement of the primarily affected organs is ascertained to be of a tractable nature; and even those of an inflammatory or incipient structural character are no longer looked upon as desperate. Thus acute endocarditis and pericarditis, though very serious maladies, are, at least in their earlier stages, by no means of necessary or even usual fatality, if treated with judgment and vigour. Simple hypertrophy of the heart, especially where the size of the cavities is little altered, and their orifices little affected; slight thickening of the valves, when not carried to such a degree as to interfere with the passage of the blood, or to admit of reflux; adhesions, and organised depositions on the surface of the pericardium, are not incompatible with a very considerable prolongation of life, or even with the attainment of old age, where the sufferer is placed in favourable circumstances, and adheres strictly to habits of temperance and self-control, and the modes of treatment hereafter to be detailed. Yet, even after all these deductions, the list of incurable affections of the heart is still, and will probably ever remain, peculiarly formidable, inasmuch as some of the structural changes to which it is liable are not only of a permanent and unmanageable nature in themselves, but are so situated as almost necessarily to induce morbid alteration of a constantly augmenting character in the adjacent portions of the organ; a result unhappily promoted by the obvious impossibility of placing it in a condition of repose. Of this nature are ossifications and vegetations on the valves, incapacitating them for the due fulfilment of their office; conspicuous narrowing of the orifices; and most instances of chronic inflammation of the pericardium, especially if attended with an abundant or purulent effusion. And, finally, there are certain conditions of the organ which are in their very nature mortal, and that almost immediately; such as rupture or wounds of its parietes, extensive polypous concretions within its cavities, and inordinately prolonged syncope, more particularly when occurring in connexion with extensive organic disease.

General Principles of the Treatment of Cardiac Diseases.

The treatment varies so totally, according to the different kinds of disorder, that most of what we have to say on the subject must be reserved till we come

to treat of the individual affections in detail. We may however here remark, that there is no class of diseases in which the necessity of early and decided practice is more obvious, and in which, consequently, the importance of a correct diagnosis to render such treatment applicable, or even safe, is more unquestionable. The mischief is too often of an irreparable nature, which ensues from mistaking an inflammatory affection of the heart for one of a merely functional or nervous character, and thus losing for ever the period in which alone active antiphlogistic measures might suffice to control the morbid action, and to anticipate its fearful train of organic changes. Plentiful and rapidly repeated abstractions of blood, both general and local, constitute here our chief resource, and are to be practised both with a view to directly influencing the inflammatory action, and also, by quickly reducing the quantity of the circulating fluid, to diminish, as far as may be safely practicable, the distension and labour of the suffering organ; for to place it in a state of absolute quiescence is, as already remarked, unfortunately incompatible with the very nature of its functions. And next in importance comes unquestionably the rapid introduction of mercury into the system, — an agent of such well known efficacy in controlling inflammatory action, preventing or limiting the effusion of coagulable lymph and serum, and promoting their absorption when already thrown out, that the neglect of its early employment in any severe case would be quite unpardonable. Its efficiency is commonly much heightened by combination with opium; and where the skin is dry and harsh, and the fever runs particularly high, by the addition of antimony; or, especially if the affection be of a rheumatic origin, by the simultaneous exhibition of colchicum. At a somewhat more advanced period, counter-irritation, as we shall hereafter see, affords invaluable aid; and where organic disease is established, and on the advance, this, along with the moderate use of mercury during periods of aggravation, forms perhaps our chief therapeutical resource.

If the dangerous consequences of overlooking inflammation where it exists be so conspicuous, on the other hand the evil of confounding a functional or sympathetic derangement of the heart's action with one of inflammatory or organic origin, though generally not so immediate in its manifestation, nor so rapidly destructive of the chances of recovery, may yet lead, not only to an unnecessary aggravation of the patient's sufferings, but, especially in anæmic and feeble individuals, to a termination as surely, though not so quickly, fatal, provided the error be not discovered in time, and the ill effects of loss of blood and other lowering measures studiously counteracted by a tonic treatment and restorative regimen. In cases where symptomatic affection continues long to be mistaken for idiopathic or organic, the organ, whatever it may be, which is really in fault, and the neglected source of all the secondary disturbance, may all the while be running on into incurable disease.

Finally, where considerable organic mischief already exists, a perfect cure of the disease being out of our reach, it only remains to endeavour to palliate its symptoms, and prevent or retard its extension: and this, chiefly, by avoiding all the known exciting causes, reducing, principally by dietetic means, the action of the organ as low as is consistent with the health of the body generally, and enjoining a life of tranquillity, both moral and physical, together with the advantages of a mild pure atmosphere, and easy exercise, especially gestation. On the more strictly medical measures conspiring to the same desirable result, we shall defer entering at present, and content ourselves here with merely reminding our readers that cases of established organic disease require great discrimination and caution, in respect to the employment of depletions; and that instances of dilatation, with thinning of the parietes of the heart in particular bear large bleedings extremely ill; and also that the due regulation of the digestive organs, the promotion of all the natural secretions and excretions, and keeping the mass of the blood moderate in quantity, but without impoverishing its quality, are objects never to be lost sight of.

We next proceed to the investigation of the special diseases of the heart.

NERVOUS AFFECTIONS OF THE HEART.

Since organic affections of the viscera have begun to attract so large a share of attention, those derangements, where no obvious accompanying physical change can be detected, have often been passed over in comparative silence. The *neuroses* of the heart have thus been altogether neglected by Corvisart, and even by Laennec but too cursorily noticed; whilst Testa and many other authors have so mixed up their accounts of them with those of structural disease, that no very distinct impression as to their nature is left on the mind of the reader. Yet of the reality of their existence, and we should have thought of their importance, even the most superficial investigation affords decisive evidence. Examples of disordered action of the heart in its mildest form, so mild and passing as not to fall under the category of disease, are furnished by the momentary palpitations induced through the influence of strong mental emotions, or by violent exercise, or other temporary physical excitements. It is only where, from the extreme sensitiveness of the nervous system generally, and of the cardiac nerves in particular, the recurrence of such irregular action becomes very frequent or distressing, and takes place from unusually slight or imperceptible causes, that it comes under the notice of the physician.

Under nervous affections of the heart are comprehended,—1. *Palpitation*; 2. *Syncope*; 3. *Angina pectoris*; 4. *Neuralgia of the heart.*

NERVOUS PALPITATION.

Idiopathic and Sympathetic.— Causes.— Diagnosis.— Treatment.

Palpitation is that peculiar condition of the heart's movements wherein they become disagreeably perceptible to the patient; and is usually, as we have seen, accompanied by irregularity, as well as by an increase of the force and frequency of the pulsations. Palpitations, where they take place without any change in this organ cognisable to our senses, are termed nervous or functional; and these may be either *idiopathic*, depending on exalted sensibility of the cardiac nerves, rendering them susceptible of undue excitement from circumstances which, in their ordinary condition, would have no such effect; or *sympathetic*, when produced by the reaction of disorder or disease in some other organ. There are two very opposite conditions of the system in which they are peculiarly apt to occur, namely, the plethoric and the anæmic; states which are in themselves alone often quite sufficient to cause derangement of the heart's action, and which, whenever they exist strongly marked, will greatly modify such derangement, whatever additional or immediately exciting cause it may have. That an excess of blood of a more than ordinarily stimulating quality, complicated, it may be, with over-activity of the capillary system forcing this fluid too rapidly in upon the heart, should often lead to embarrassment of the organ, is only what we might expect. Nor, on the other hand, does it appear very surprising when there is a deficiency of this fluid, accompanied as it usually is by a notable deterioration in its composition, as well as by increased mobility of the nervous system, that the heart should, in this its altered condition in respect to excitability, chemical stimulus, and distension, often contract in an irregular or spasmodic manner. That the fact is so, whatever may be its true explanation, we have ample evidence in cases of anæmia induced by over-depletion or by deficient nutriment; in which the blood is not only diminished in quantity, but also impoverished in respect to its fibrin and colouring matter, or otherwise impaired in quality; as likewise in the allied instances of chlorosis and scurvy, in all of which palpitations are amongst the most ordinary symptoms.

The chief remaining predisposing causes of such palpitations, in addition to those just mentioned, are a nervous or irritable temperament, youth, and debility.

In respect to duration, violence, and frequency of recurrence, these palpitations are susceptible of innumerable varieties, being characterised by all the waywardness and uncertainty of nervous affections generally. Thus, they may last but for a few minutes, or persist for whole days almost uninterruptedly; they may recur only at distant intervals, or, on the contrary, several times within the twenty-four hours. The impulse of the heart is generally increased, as are likewise, and in a still more remarkable degree, its sounds, which are often accompanied by a metallic ringing *, from the impulse of the organ against the parietes of the chest, and are frequently distinctly heard as well as felt by the patient himself. A bellows murmur is sometimes heard in the præcordial region, accompanying the first sound of the heart, and also in the arteries, in which it occasionally assumes the musical, moaning, or cooing character: the remitting humming tone, formerly described is in many cases audible, though this latter, as already stated, has probably most frequently its seat in the veins; the periodic swell, when it exists, depending on the interrupted pressure of a subjacent artery at the moments of its successive pulsations, or, if very loud, on a simultaneous murmur in this latter vessel.† There is also throbbing of the arteries, the pulse being short and jerking, occasionally with a thrill, but without the strength or resistance of the inflammatory pulse; and the contractions of the heart are, in some rare instances, attended with pain. The respiration is frequently embarrassed, whilst flushing of the face, ringing in the ears, and other nervous symptoms commonly co-exist, with a sense of restless anxiety referred to the præcordial region, and sometimes a tendency to faintness and syncope. In chlorotic patients, palpitations which are, as we have seen, amongst the most common and distressing symptoms, are often accompanied by dyspnœa on slight exertion, as in going up stairs for instance, and sometimes by œdematous swelling of the face and extremities. The derangement of the heart here assumes a good deal of the passive character, the palpitations being obviously the efforts of a weak organ, and producing sometimes even less impulse than in the natural condition, notwithstanding the distress complained of by the sufferer. Palpitations of this kind are peculiarly intractable, and are accompanied with great præcordial anxiety, and a sense of vague apprehension. In scurvy, likewise, in which the blood and muscular tissue, and indeed all the solids and fluids are so remarkably altered, difficulty of breathing and infiltration of the cellular membrane are very frequently associated with violent palpitations.

Amongst the more frequent *exciting causes* of nervous palpitations are to be reckoned not only the stronger mental emotions, such as joy, fear, or anger, but also those of a more depressing and prolonged character, as sorrow, care, or longing. Protracted mental exertion, late hours, sexual excesses, uterine derangements, large depletions, hæmorrhages, or exhausting discharges; in short, whatever tends to debilitate the system generally and augment the nervous excitability, favour their production. The dyspeptic and hypochondriacal, the gouty and the hysteric conditions are peculiarly prone to them. Irritation of the stomach or intestines, as by the ingestion of food in excessive quantity, or of a flatulent, indigestible, or acrid nature, and the presence of worms, and more especially tænia, are well established causes of such palpitations. In some individuals the presence of an excess of acid in the stomach, or its over-distension from flatulence, is sufficient greatly to derange the heart's action, and render it strikingly irregular or intermittent. Partly through the medium of sympathy, and partly in consequence of pressure, an enlarged liver or spleen or other abdominal tumours, ascitic effusions and the gravid uterus

* Dr. Hope, as we have already seen, rejects this explanation, and ascribes the augmented intensity of sound to the vehemence of the valvular and muscular tension at the instant of the reaction of the contained blood against the contracting walls of the ventricles; the sound being, in certain cases, still further reinforced, towards its termination, by the tripping of the apex against the margin of the fifth rib.

† The *musical* murmurs, also, are supposed by Dr. Hope, from their sustained character and usual coexistence with the continuous venous hum, to have their origin in the *veins*.

exercise a marked influence in the production of palpitations, as does likewise compression of the abdomen and chest by the absurd practice of tight lacing. Addiction to spirituous potations is a very frequent source, not only of this functional disorder of the heart, but often, we believe, also of organic disease. How powerful an agency both tea and coffee exert in deranging the motions of the heart, in particular idiosyncrasies, is not commonly fully appreciated in this country, where their long habitual use as articles of diet has in a great degree blunted our curiosity as to their energetic qualities. Yet it is a well established fact that tea, whether black or green, even of moderate strength, will, in some individuals, and especially those who are abstinent in respect to wine and other fermented liquors, and who are of studious and sedentary habits, produce violent disorder of the heart's motions, rendering them at one time vehement and tumultuous, and at another so irregular, intermitting, and feeble as to threaten instant deliquium. The respiration likewise occasionally becomes irregular and oppressed, and there is sometimes acute spasmodic pain in the præcordial region, together with much of the mental anxiety which characterises an attack of angina pectoris. These effects are, as we have satisfied ourselves, by no means rare; many individuals continuing to suffer from them in various degrees for months and even years without ever suspecting their origin. When once ascertained to be productive of these consequences, this beverage should of course be at once and permanently renounced. The distressing sensations alluded to above may, however, be entirely and almost immediately removed for the time by a glass of brandy or other strong stimulant.

Embarrassment of the pulmonary circulation may likewise give rise to palpitations, whether caused by hepatisation of the lung, or the presence of tubercles in large quantities, or by the encroachment of a tumour or of a fluid within the pleural sac; and an irregular or rachitic conformation of the thorax, likewise favour their occurrence in a remarkable degree, as pointed out by Testa. Spinal irritation, more especially when seated in the cervical or dorsal regions, is ordinarily accompanied with a disposition to palpitation; but whether the latter be a direct consequence of the former, or whether it is merely a concomitant result of a more general cause, we shall not here stop to inquire. Palpitation is also a frequent symptom in chorea, and during the debility of convalescence from protracted fevers; and is likewise often a very distressing one in cases of mercurial erithism. We have read of obstinate palpitations being induced, along with severe dyspeptic symptoms, by the irritation of caries of the teeth and alveolar processes, and ceasing on the removal of the diseased teeth; and doubtless many other examples of inordinate or irregular action of the heart brought on from sympathy with painful affections of distant parts might be adduced.

There is still another species of palpitation which has been briefly alluded to by M. Bouillaud, under the title of rheumatic palpitations, often coexisting with wandering pains in the neighbourhood of the præcordial region, and radiating thence towards the left arm. They are occasionally accompanied with intermittence of the pulse, and give rise to considerable alarm on the part of the patient, who may yet be in the enjoyment of good health in all other respects. It can scarcely be necessary to caution the reader against confounding this, which appears to be a rheumatic affection of the cardiac nerves, with the palpitations connected with the rheumatic inflammation of the linings of the heart afterwards to be mentioned.

Diagnosis. How much unwarrantable suffering is inflicted on individuals and families by the deplorable but unfortunately too frequent error of confounding nervous affections of the heart with those of an organic nature, is but too well known to need to be more than simply mentioned here. It is only however of late years, or since more accurate grounds for forming a diagnosis of these two very opposite classes of disease have been furnished by the discovery and judicious application of the physical signs distinctive of each, that the better informed portion of the profession has become fully aware of the extent to which such error must have formerly existed. We do not however pretend to say

that even yet every individual case can be satisfactorily referred to its true head, though certainly a very encouraging advance towards so desirable an object has been, within our own memory, effected. When the supposed nervous palpitations are of very frequent recurrence, or continue for a very considerable period, we may still sometimes find it far from easy to make up our mind decidedly as to their real origin; and where they exist, as is often the case, in complication with structural disease of the heart, to recognise their nature, and their precise share in the existing disorder of the functions of the organ is often a matter of extreme difficulty. Bouillaud has given a very striking example of this puzzling complication in the case of a young, nervous, hysterical female, labouring under amenorrhœa, in whom violent palpitations recurred on the slightest causes. Even feeling her pulse at the hospital visit would send the blood at once into her face, and induce vehement action of the heart, with attacks of a spasmodic character, which often passed into an hysteric paroxysm. And yet with all this fallacious nervous susceptibility, by which many a careless observer might have been led to neglect all further examination of the case, there existed enormous hypertrophy of the heart, with induration of the valves of the left side, dating their origin from an attack of articular rheumatism. It appears to us that Dr. Hope goes quite too far in saying "that the diagnosis presents no difficulty to one who to general signs adds a knowledge of those afforded by auscultation and percussion." And even Bouillaud expresses himself somewhat too confidently on this point. Andral, on the contrary, less sanguine, admits that cases will sometimes present themselves when the distinction is almost impossible; both from the circumstance of the symptoms even of a really organic disease of the heart, on the one hand, occasionally almost entirely disappearing for a time; and on the other, from the action of the heart not always completely regaining its normal condition in the intervals of a purely *nervous* palpitation. Thus, for example, a bellows murmur, or some other irregularity of the circulation, may persist for a considerable time in connexion with some slight dyspnœa, indicative of a certain degree of pulmonary congestion; for this latter condition, no less than the palpitation, may, and doubtless does, often originate under the sole influence of a nervous temperament. Besides, as he judiciously remarks, when nervous disorder passes into organic disease, as is sometimes the case, there must be a period in the transition where it will be impossible to ascribe the symptoms positively and exclusively to either.

There is still another class of cases, and of by no means rare occurrence in practice, as to which considerable hesitation is often experienced, namely, when some very slight organic change in an inconsiderable portion of one or other of the lining membranes of the heart still remaining, after an otherwise successfully combated inflammatory attack, gives rise to fugitive palpitations, under the influence of slight exciting causes, though the organ presents no obvious signs of disease in the intervals.

Enough having been said to prove that the recognition of nervous palpitations is not always without its difficulties, it remains for us to enumerate the best means we are as yet in possession of for endeavouring to surmount them.

By percussion, auscultation, and inspection of the præcordial region, we strive to ascertain whether there exists hypertrophy or dilatation of the heart, obstruction of the orifices, or imperfect action of the valves, or any of the results of pericardial inflammation; of the characteristic signs of each of which we shall afterwards speak.

In nervous palpitations, says Laennec, the sounds of the heart, though clear, are not loud over a great extent, and the impulse, though it appear strong at first, does not sensibly throw up the head of the observer. It was on this latter circumstance, taken in conjunction with the increased frequency of pulse, that he chiefly relied for their recognition. The extent of surface over which such palpitations are audible, is, however, sometimes much more considerable than his statement would prepare us to meet with, as they may at times be heard, not only over the whole chest, but even before the head is brought into close con-

nexion with it. The shock of the heart, in cases of nervous excitement, has an "abrupt bounding character," and does not raise the head with the gradual heave of hypertrophy; and the pulse, though it may not be strong, or though it should even be decidedly small and weak, is again, to use the words of Dr. Hope, ordinarily "sharp and jerking." Both this character of pulse, and the bellows murmur which often coexists with it, depend on the spasmodic quickness, and not on the force of the systole.*

In the intervals between the successive attacks of palpitation, when of nervous origin, the action of the heart and arteries is ordinarily natural; and the bellows murmur is of a less permanent character, and often affected by very slight causes, as by a change of posture, taking of food, a passing emotion, &c. Palpitations of this kind, too, are commonly much more distressing to the patient than is the over-action of the heart connected with organic disease, at least in its earlier stages. Of the latter there is sometimes a complete absence of consciousness; whilst the former, on the contrary, are the source of perpetual complaint. This internal perception is indeed highly characteristic of nervous palpitation. The different effects of motion and rest on the two kinds of disease are also very conspicuous. Insufficient exercise, especially in combination with too high a scale of diet, when the subject is plethoric, is sure to exasperate the nervous variety; and it is in the recumbent posture, and during the attempts to procure repose in the earlier part of the night, that the annoyance from them is most marked; and they are least noticed when the individual is actively employed in the open air. In cases of organic affection, on the contrary, the least over-exertion leads to immediate exasperation of the symptoms, distressing dyspnœa, &c., and the over-action of the heart is commonly more prolonged. The most obstinate palpitations met with in practice are those when dilatation coexists with thinning of the walls of the heart. Laennec mentions such a case, when the palpitations persisted for a week, the pulsations being all the while of enormous frequency.

By a consideration of coexisting symptoms, as well as of the temperament and time of life, and of the period which has elapsed since the commencement of the disorder, much additional light may be thrown on the nature of the case. When the patient is of a very irritable habit, or subject to other affections of a nervous character; when the attacks are accompanied by an abundant flow of pale urine; or, finally, where dyspepsia, or any of the other exciting causes above alluded to, have preceded the tendency to palpitation, we shall have reason to hope, at least till fuller investigation has been made, that the disorder of the heart may be only functional. Too much stress is, however, often laid on the presence of dyspeptic symptoms, as if almost diagnostic. It should not be forgotten that derangement of the stomach, and even the temporary distension caused by food or flatulence, may very materially aggravate those palpitations, also, which have their origin in organic disease.

The period of life most subject to nervous palpitation is that of puberty, and for a few years subsequently. It is very common in students, and more especially those of the medical profession, whose attention is so much directed to their organisation; in females, likewise, in the flower of youth, and more particularly those in whom the menstrual function has either not been fully established, or become in some respect deranged; in puerperæ, especially after large losses of blood; and in pregnancy, from sympathy with the enlarged uterus, from the pressure it causes, as well as from the accompanying plethoric condition of the system. Organic affections of the heart, as is well known, ordinarily make their appearance at a more advanced period of life, and often in persons of the stoutest make and most active habits.

When palpitations are of the nervous kind, there is occasionally felt a

* Dr. Hope rests his diagnosis on the circumstances of the murmur being always weak, and of the soft or bellows kind, systolic, and confined to the aortic orifice, and, in the anæmic, audible only whilst the pulse continues accelerated, as well as on its being, in such subjects, almost invariably accompanied by venous and arterial murmurs. (Page 386.)

pricking sensation over the præcordial region; and on applying the stethoscope, the increased action, unlike to what takes place usually in organic disease, is equally audible on both sides of the heart. Congestions of the chest and head, moreover, are rare; there may, indeed, be uneasy or painful temporary nervous sensations connected with the brain, the senses of sight or hearing; but no evidence of permanent cerebral determination, such as heavy dull pain of head exasperated by stooping, throbbing of the temporal arteries, prominence and redness of the eyes, excessive sleepiness, stupor, and apoplectic tendency; nor is there in most of its varieties, even after their long continuance, with the exceptions to which we have already alluded when speaking of chlorosis and scurvy, any marked disposition to dropsical effusion. The results of treatment and of attention to diet, air, and exercise, and the careful avoidance of all exciting causes, will tend still further to clear up the nature of the case.

Treatment. As nervous palpitations vary so much in respect to their causes, and the states of body in which they make their appearance, very different and even opposite plans of treatment are obviously required by them. There is one rule, however, which is applicable to all, namely, to remove the exaggerated apprehensions of the sufferer by assuring him, where it can be done with truth, of the absence of organic disease; the very dread of which has so powerful an influence in exasperating the symptoms. To modify as far as possible any thing morbid in the general habit of body, and to avoid the exciting causes of the attacks, wherever they can be discovered, are self-evident indications, in the neglect of which, and more particularly of the latter, all other measures will for the most part prove quite unavailing.

A plethoric condition is to be combated by a reduced scale of diet, active exercise, early rising, and aperients, in addition to which the local or general abstraction of blood will sometimes be necessary.

An anæmic or chlorotic state, on the other hand, requires a liberal supply of light nutritious food, a pure dry bracing air, agreeable occupation, easy exercise, frequently repeated in the course of the day, and in conjunction, if possible, with change of scene. In connexion with these, tepid or cold shower-bath or sea-bathing may be had recourse to, along with the exhibition of tonic medicines, more especially artificial preparations of iron or chalybeate mineral waters, bark, quinine, the vegetable bitters, with the alkalies or mineral acids, and occasional warm aperients. Nitrate of silver, in combination with extract of hyoscyamus, is spoken of with commendation by Dr. Copland: it is a medicine, however, not to be lightly had recourse to, nor from the well-known inconveniences connected with its long-continued use, to be too perseveringly exhibited. The same author has seen a strong infusion of green tea, taken three or four times a day for some days in succession, quiet obstinate nervous palpitations; but from its well-known power of deranging the heart's action in many individuals, and of itself producing violent and irregular action of the organ, of which we have met with numerous instances even in stout and active individuals, we apprehend that the cases in which it will prove useful are but few.

In both varieties of the disease above alluded to all coexisting disorder of other organs, and more especially of the uterine and digestive system, is to be carefully investigated, and, if possible, removed. In amenorrhœa, occurring in connexion with the plethoric condition, the application of leeches to the thighs, along with aloëtic purgatives, will often be of service; but when this functional derangement originates, on the contrary, in the chlorotic state, all attempts at removing either it or the associated palpitations, will probably fail, till the morbid state of the system at large, of which it appears commonly to be but one of the manifold effects, has been in some degree counteracted. Griffith's mixture, or pills of the sulphate iron, along with aloes and myrrh, to which in some cases a moderate portion of a narcotic extract, to counteract irritation, may be added, will tend in some degree to fulfil both the local and the general indications; but it is chiefly on the dietetic resources already insisted on that we must place our dependence. As to the palpitations so often occurring in

hysteria, they generally fall under one or other of the varieties we have been treating of; and for any further peculiarity of management required by them, we must refer to the article specially devoted to that protean affection. The appropriate treatment of dyspepsia, likewise, will be found at length in another portion of this work; so that we need here only remind the reader of the importance, in such cases, of avoiding all indigestible ascescent or flatulent kinds of food, and of abstaining from such excess, whether in solids or liquids, as would over-distend and debilitate the stomach. Immediate temporary relief of the palpitation is sometimes consequent upon the exhibition of an antacid, a carminative, or a mild emetic, when there is reason to suspect that the stomach has been overloaded with food, distended with gas, or irritated by acidity. In cases where there exists considerable irritability of stomach, prussic acid has been found by Dr. Elliotson of so much use that he is disposed to consider the marked relief afforded by it as almost diagnostic of functional derangement arising from this source. The bowels should be regulated, but by no means powerfully acted on. Many dyspeptic and more especially delicate females, often, we believe, induce or exasperate palpitations of the heart by the injudicious use of drastic purgatives. Where they appear to be connected with congestion of the liver, its secretion should be freely promoted, and a few leeches applied, either over this organ, or, still better, to the hæmorrhoidal vessels. When the suppression of any habitual discharge, or the sudden removal of a cutaneous eruption, has been followed by palpitations, the establishment of some vicarious action is the practice which both reason and experience indicate as best. If the affection is connected with gout, an habitually free state of the bowels is peculiarly important, and should be effected, if possible, through the medium of the diet; otherwise by the use of an appropriate aperient, and more especially by the free use of magnesia. The fluid effervescing preparation of this medicine, invented some years ago by Sir James Murray, is peculiarly suitable in these cases, where its use has to be so long continued, inasmuch as it has neither the disagreeable taste nor liability to concrete within the bowels, of the ordinary form. During the fit of palpitation, which is often very violent and attended with peculiar anxiety and sense of sinking, an opiate or some of the milder narcotic extracts may be given with advantage, in strong camphor mixture or some other cordial medium.

The existence of spinal irritation, where an altered regimen and the enjoyment of a pure country air fail of procuring relief, calls for the application of leeches and counter-irritation to the tender portion of the back. Where the palpitations seem to depend on extreme excitability of the nervous system generally, and of the cardiac nerves in particular, independent of any discoverable disorder in other organs, digitalis or prussic acid may be cautiously had recourse to, along with active and continued counter-irritation over the præcordial or corresponding dorsal region: whilst at the same time every means of favourably modifying the prevalent nervous temperament should studiously be put in practice,—such as living much in the open air; adhering to early hours; using as much exercise as is consistent with the strength; practising temperance without abstemiousness; and, above all, keeping the mind at ease, and not over-working the brain.

As to the palpitations which accompany the different kinds of asthma, we must refer for their treatment to the various diseases of the heart and lungs, of which the asthmatic paroxysm is symptomatic.

SYNCOPE.

Symptoms. — Causes. — Effects of the injection of air into the veins. — Diagnosis. — Treatment of syncope founded on its various causes.

Syncope, or that temporary loss of consciousness and motion which ensues when the brain, in consequence of the sudden depression of the heart's action,

is no longer adequately supplied with blood, is, as we shall have occasion to notice in a subsequent part of this work, a frequent and very alarming symptom in many organic diseases of the last-named organ; but it is also prone to occur from very slight causes, in the absence of all such structural change, in those of a nervous and debilitated habit, and more especially in delicate females of the upper and more artificial classes of society, who are too often rendered morbidly susceptible by luxury, indolence, and self-indulgence.

The precursory *symptoms*, ordinarily present, consist in a painful sense of faintness*, sinking, or dead sickness; clouded vision, with the perception of various imaginary colours; ringing and rushing sounds in the ears; vertigo and confusion of head; coldness and tingling in the extremities, and cold perspirations, along with extreme paleness and collapse of the features. In some rare instances, as, for example, where the mind receives a sudden shock, syncope has been known to take place immediately, and without the occurrence of any of these warning signs. Where the individual faints outright, the breathing becomes almost imperceptible; consciousness is extinct; the pulse at the wrist can no longer be felt; the contractions of the heart are extremely feeble, its first sound being greatly diminished in intensity, whilst its second sound is commonly inaudible.

This condition continues for various periods, from a few seconds to some minutes; or, in a minor degree, even for hours or days, as in those embarrassing cases of suspended animation which are, occasionally, with so much difficulty distinguishable from death.

As the fainting fit goes off, the respiration becomes stronger; reaction manifests itself in the circulatory system in the increasing energy of the heart's pulsations and in the refilling of the capillaries, as well as in the gradual though often painful return of consciousness and voluntary motion.

Of the *causes* productive of syncope, some act primarily on the brain and nerves; as, for example, peculiar odours and powerful miasmata, disgusting or painful sights, affecting strains of music, mental shocks, destructive bodily injuries, agonising pain or intense pleasure, concussion or inflammation of the brain or ganglionic centres, fatigue, inanition, &c. Others produce their effect through the medium of the circulation, as excessive losses of blood, as in the case of surgical operations, wounds, or floodings after delivery; or profuse evacuations, as in cholera, violent diarrhœa, prolonged lactation, or the sudden removal of pressure off the abdominal vessels and viscera, as in the case of parturition, or rapidly drawing off the fluid in ascites, especially when proper bandaging is neglected. Even the premature assumption of the erect or sitting posture by convalescents from fever, or others in an extreme state of debility, is often sufficient to produce a very dangerous or even fatal syncope; these postures, as we have already seen, having a very considerable power of weakening the force of the heart's pulsations, and apparently exhausting the irritability by the enormous augmentation of its speed: nor can we believe that the gravitation of the blood is in such instances without its influence.

In the very opposite condition, or that of plethora, syncope is likewise not an infrequent occurrence, appearing to originate in a temporary oppression of the heart and great vessels. Instances from this source are not rare in pregnancy and certain forms of hysteria; though, in regard to both, the co-operation of sympathy or coexisting nervous disturbance is not to be overlooked. It will, indeed, be found impossible in many other instances as well as these to refer the exciting agency to a simple source: thus, in respect to many of the various poisons, mineral and vegetable, by which syncope may be induced, part of the influence is ascribable to the direct action on the nervous system, part to the extreme exhaustion consequent on the incessant discharges, and part to sympathy of the heart with the suffering organs. Some, however, manifest their influence over the heart with peculiar rapidity: the fatal syncope induced by prussic acid is

* This is not universally true; in some individuals the sensation is decidedly pleasurable: such was the case with Montaigne

almost instantaneous; that from tobacco very rapid; whilst the tendency to the same result when induced by digitalis is, on the contrary, of a peculiarly insidious and accumulating character, being brought on by even small doses of this substance when long continued, and persisting for a considerable time after they have been renounced.

The tendency which exposure of the surface of the body to a high temperature has to produce fainting is familiarly known in the instances of hot bath, overheated apartments, standing long with the back to a powerful fire, &c.; the effects being ascribable to the influences of these causes as well on the nervous system as on the distribution of the blood.

Amongst the most rapid and fatal instances of syncope is to be placed that induced by the forcible and sudden *injection of air into the veins*, which, after it has reached the heart, seems immediately to arrest the circulation. As to the primary cause of death under such circumstances, there has been much difference of opinion amongst physiologists. By Nysten and Bichat it was ascribed to the effect of the air on the brain (compression of the organ, according to the former, being produced); by Boerhäave to the clogging of the pulmonary capillaries, and consequent interruption of the circulation; by Leroy to emphysema of the lungs; and by Magendie to loss of power in the right ventricle from over-distension. A much more satisfactory explanation than any of these was proposed a few years ago by Dr. John Macdonnell.*—"What will usually be found to occur," he observes, "is this: the injected air is quickly conveyed to the right auricle, the contraction of which drives it partly back in the veins, partly into the ventricle. The auriculo-ventricular valve is incapable of completely confining the air; and, instantly that the auricle relaxes, it is again filled with air, partly from the ventricle, partly from the veins. In this way the auricle will be observed, at the instant of each relaxation, to become distended with air, which thus stops the circulation, and, of course, causes death." As to the causes to which Nysten and Boerhäave attribute it, he does not deny the possibility of their being occasionally concerned, but successfully impugns the hypothesis of Magendie as being quite incompatible with the observed facts; for blood and air mixed continue to be forcibly ejected from the wounded vessel even after the animal has become insensible, which indicates sufficiently that the right side of the heart continues capable of powerful action.†

* Dublin Medical Journal, July, 1835.

† The occasional spontaneous introduction of air into the larger veins in the neighbourhood of the heart, during surgical operations, has excited much interest of late years since attention was first called to it by Beauchêne, and more particularly since the occurrence of Dupuytren's celebrated case. The experiments made before the recent Commission of the Royal Academy of Medicine, by M. Amussat, have thrown some new light on this obscure subject. From these it appears that it takes place only in that portion of the great veins which are situated near enough to the chest to be the seat of the venous pulse, or that flux and reflux of the blood taking place under the influences of the respiratory movements, — as the lower third of the external jugular, for instance, and the subclavian vein; or if such introduction of air occasionally occurs in somewhat more remote parts, it is only when the orifice in the vessel is held open, and not even then in veins which are considerably more distant, as the brachial, for example.

Where air is artificially injected into the veins of the lower animals, the effect varies with the quantity introduced, and the force and rapidity with which it is thrown in. Thus, in some instances, death ensued within two or three minutes; in others, though there was an appearance of extreme anxiety, with great embarrassment of the respiration and circulation, extreme debility, convulsions, and tetanic spasm, death did not take place for near half an hour; whilst in others again, when the quantity was very inconsiderable, little uneasiness was manifested, and the animal speedily recovered. The physical signs of air in the veins were a lapping or gurgling noise within these vessels, synchronous with the inspirations, and occasionally also with the diastole of the heart, in which organ, likewise, a bellows-murmur was heard, with or without a gurgling sound. On dissection, if immediately performed, the right side of the heart and the pulmonary artery were found distended with frothy blood; the left side at this period being entirely free from it, unless in such large animals as the horse, where the greater size of the capillaries of the lungs was supposed to have admitted more readily of its passage. In some instances, the veins of the brain and other parts of the body already contained air; and it existed in them universally, as well as in the arteries, where the animal had survived the experiment, and not been put to death till some days afterwards.

The proximate cause of death is supposed by the Commission to be threefold. 1st. Enormous distension of the heart, and consequent impediment to its contraction. 2d. Embarrassment of the pulmonary circulation by the spumous blood in the branches of the pulmonary artery. 3d. Compression of the brain by the air in its veins, in some instances.

A large draught of cold water, taken whilst the body is over-heated and debilitated by violent exercise, has been known almost immediately and entirely to arrest the heart's action. But, of all agents, electricity in an accumulated form is that which most instantaneously and irrecoverably puts a stop to the heart's motions, seeming to act simultaneously on the nervous and muscular systems and on the blood, destroying at once the sensibility of the first, the irritability and contractility of the second, and the power of coagulation in the last.

The cases in which fatal syncope more usually presents itself in practice are either those in which, there having been extreme previous debility, some unsuitable posture has been assumed, or some exhausting muscular effort attempted, some intensely painful operation performed, or injudicious evacuation practised; or those in which sudden and irreparable exhaustion has been induced by an inordinate loss of blood; or, finally, those in which the heart has long been suffering from a state of organic disease, as softening or atrophy of its tissue, or passive dilatation of its cavities. In the last-mentioned order of cases, so great is occasionally the weakness of the circulation, that a portion of the blood seems sometimes to coagulate within the heart before life is yet extinct; the polypous concretion so formed becoming the immediate cause of the fatal syncope. A few instances are on record of individuals who have died quite suddenly without any sufficient apparent cause, and in whom dissection having discovered nothing besides an empty and flaccid state of both sides of the heart and of the venæ cavæ, we are obliged to refer the fatal termination either to deficient energy of the cardiac nerves, or to weakness of the muscular parietes of the organ, or, in short, to a species of paralysis.

Diagnosis. Syncope may readily be distinguished from the partial loss of consciousness occurring so frequently in hysteria, and depending generally on temporary congestion of the brain rather than on deficient circulation within it, by the colour of the cheeks and lips in the latter affection, by the continuance of the arterial pulse, and finally by the accompaniment of other hysterical symptoms, as globus, pain in the left side, alternate fits of laughing and crying, &c.

The Leipothymy of Sauvages, or that condition which is characterised by the fixed eye and appearance of abstraction, or rather of impaired consciousness, by the momentary cessation of voluntary motion and by the restrained respiration a condition which so often ushers in the epileptic paroxysm, and which seems to consist in a passing congestion of the cerebral vessels, may be discriminated at once by the pulse remaining firm throughout the seizure, as may likewise the epileptic attack itself by the same circumstance taken in connection with the violent agitations of the body, the foaming at the mouth, &c. Apo-

As to remedial measures, those which appear to promise most benefit are,—frequent compression of the chest, the vein being kept closed in the intervals; the abstraction of air or froth with the syringe; and, lastly, free bloodletting, the efficacy of which was accidentally discovered by Nysten.

There are on record nearly forty supposed cases of the accidental introduction of air into the veins in the vicinity of the chest, in operations on the human subject; yet in very few of these is the actual occurrence of such an event satisfactorily established. Dupuytren's, and perhaps half a dozen others, may be admitted as genuine. In these there was heard either a gurgling noise, or a sound of air rushing through a narrow aperture; and this was, for the most part, almost immediately followed by fatal syncope. In one instance, death ensued almost instantly after opening the jugular vein for the abstraction of blood in a case of apoplexy. In all the indubitable examples of the accident in question, air was found in the vessels, both arteries and veins, of the brain and rest of the body, and in some of them also in the right ventricle of the heart. Still it is far from certain that the air so introduced was always the sole or even principal cause of death; for, in the first place, there were numerous other influential causes in operation, as loss of blood in some instances, exhaustion from pain or fear in others, oppressive determination to the head in others: and, in the second place, the symptoms and effects differ considerably from those induced by the direct injection of air in the lower animals; convulsions were not commonly present,—death was much more sudden. Distension of the right side of the heart with frothy blood was not so constantly observed, and the quantity of air introduced was apparently much less. (See a very able analysis of the evidence on this subject, in *British and Foreign Medical Review*, No. XII.)

plexy, or pressure on the brain by effused blood or serum, or extreme congestion of its vessels, is sufficiently characterised by the heavy stertorous breathing, and commonly by the full strong pulse and congestion of the vessels of the face; as is asphyxia by the swollen livid features, and the distension of the capillaries with unarterialised blood, indicative of the function of the lungs having ceased prior to that of the heart. And, finally, real death may be distinguished from syncope by the total and prolonged absence of both sounds of the heart, and of every trace of respiratory movement or pulmonary vapour; by the cadaveric stiffness of the limbs; the sinking of the temperature in the interior of the body, as judged of by the introduction of a thermometer into either end of the alimentary tract, or under the axilla; the complete absence of all evidence of sensation, even on the application of the strongest stimuli to the nerves of the skin and to the other organs of sense; by the blackish hue of the sclerotica when it has been exposed for some time to the air; by the filmy sunken appearance of the cornea; and by the bluish or reddish streaks throughout the skin, but especially on the most dependent parts; or, if these signs fail to force conviction, by awaiting the occurrence of the odour and discolourations of incipient putrefaction.

Treatment. The objects of treatment consist in abbreviating or anticipating the attack, and, in the intervals, gradually counteracting the local and constitutional causes of its occurrence. During the period of the premonitory sensations, the obvious means of preventing the occurrence of complete syncope consist in placing the patient in the horizontal posture; the removal of all pressure of cloths, &c. on the throat, chest, and abdomen; the free admission of fresh air, to stimulate the lungs and surface of the body; cold aspersion, to excite the cutaneous nerves and call the associated respiratory muscles into full action; together with sharp volatile errhines, a drink of cold water, or, if within reach, a stimulant aromatic draught, containing either ammonia or camphor, or a glass of wine, or other easily obtained stimulant, if there be no suspicions of inflammatory disease: in short, all such means as are known temporarily to stimulate the nervous system, and augment the action of the heart and lungs. Tight ligatures on the limbs, so as to impede the flow of blood to the extremities, — once a popular remedy, — have been recently alluded to by Mr. Wardrop, who countenances their employment, and endeavours to account for their influence on physiological principles. When fainting has taken place outright, most of the above measures, with the exception of the introduction of fluids into the stomach, will still be practicable and proper, and will ordinarily suffice to shorten the attack. The common people, in such cases, often cry shrilly in the ears, slap the palms of the hands, or use other familiar methods of awakening the dormant sensibility. In instances of obstinate and prolonged suspension of animation, it may be proper to employ, moreover, stimulant injections of camphor, turpentine, &c. together with frictions of the limbs and trunk; to apply warm embrocations to the pit of the stomach and præcordial region; and avail ourselves of the agency of heat in a still more energetic form, as by means of the bowl of a spoon or head of a hammer, plunged for a few seconds into boiling water, and then brought into momentary contact with the cutaneous nerves, more especially in the situations just mentioned, or to the corresponding portion of the spine: and in extreme cases, which, from the prolonged silence of the heart, or unnatural and increasing interval between its sounds, seem to verge upon dissolution, the introduction of warm and exciting fluids into the stomach by means of an elastic tube, the assiduous employment of artificial respiration, and, perhaps, also of electricity, should be resorted to. From analogy we should anticipate benefit, in some of these cases, from the momentary dashing of cold water, from a height, on the upper portion of the spine; care being taken not to produce any permanent or general reduction of the temperature of the body, inasmuch as to support the animal heat is an indication of primary importance.

It can scarcely be necessary to recall to the reader's mind, that the pre-

vention of syncope is not always desirable; that in inflammatory affections, for instance, when bloodletting has been practised, the good effects of the operation are probably sometimes much augmented by its occurrence; whilst any attempts at preventing it, by the exhibition of stimulants, could not fail to counteract its beneficial results, and ought therefore, for the most part, to be scrupulously avoided. There are, however, on the other hand, many cases in which, though bloodletting in moderate quantity may promise great relief, as, for instance, in certain stages of organic affection of the heart, the supervention of syncope would be attended with extreme risk; and there are very few cases indeed, of any kind, in which we should venture to bleed to this extent in the horizontal posture. The ready occurrence of fainting on the loss of a very small quantity of blood may generally be considered as a proof of bloodletting being inappropriate, either to the disease in which it has been employed, or at least in respect to the period of its performance; and has been referred to, by Dr. Alison, as one of the means of distinguishing incipient idiopathic fever from the constitutional effects of a local inflammation. Dr. M. Hall thinks we have a criterion of the quantity of blood proper to be drawn in any disease, in the facility with which syncope is induced,—the patient being in the erect or sitting posture: and accordingly its supervention, from the loss of very moderate quantities of this fluid, is thought to indicate certainly the absence of formidable inflammation; whilst, on the contrary, the tolerance of very copious evacuations of this kind is looked upon as sufficient evidence of their appropriateness. Thus, for example, whilst in a state of health, incipient syncope is induced commonly by the loss, on an average, of about 15 ounces of blood; in congestion of the brain, from 40 to 50 ounces may often be taken before the same effect ensues; in inflammation of serous membranes, from 30 to 40; of parenchymatous parts, about 30; of the skin and mucous membrane, about 16; in fever and the exanthemata, from 12 to 14: whilst in delirium tremens, puerperal delirium, concussion of the brain, intestinal irritation, dyspepsia or chlorosis, and, above all, in cholera, the abstraction of a much smaller quantity will commonly have the same result. These views, however, have not been universally adopted; and Dr. Clutterbuck, in particular, whose experience in regard to bloodletting has been peculiarly extensive, has very recently raised his voice against them. Whilst he does not altogether deny that the approach to syncope in the erect posture may be a test of the quantity of blood which can be lost with safety, he asserts that it is, alone, no true measure of the quantity proper to be taken; for the period at which syncope occurs will vary with the size of the aperture, and the rapidity with which the blood escapes, no less than with the quantity drawn; and hence, if it flow very quickly, fainting may set in before enough has been obtained to make any permanent impression on the disease; and if, on the contrary, very slowly, an unnecessary and injurious diminution of the circulating fluid may be undergone before the same state is induced. And again, the observance of the rule in question would lead very commonly, it is asserted, to a wasteful expenditure of the vital fluid, as inflammations can very often be controlled without pushing depletion to the length of syncope.

In hæmorrhage from wounds, &c., fainting seems to be one of nature's remedies for promoting the contraction of the bleeding vessels, and the formation of a coagulum. When, however, mechanical means of commanding the hæmorrhage are at hand, and especially when the loss in this way has already taken place to a formidable extent, the judicious practitioner will not, of course, for a moment, hesitate to interfere and arrest the further flow of blood, and anticipate the occurrence of such a state; unless under the existence of some very peculiar counter-indicating circumstances. In syncopes connected with diseased heart, or with uterine hæmorrhage, such interposition, the peril being imminent, is loudly called for from the very first. In the former, our resources are unfortunately very limited, scarcely extending beyond the exhibition of diffusible stimuli, and the application of warmth and friction to

the surface, and other excitants of the cutaneous nerves and capillaries, in the manner previously alluded to. In the latter, the invaluable aid we possess in the tampon or plug, in the form of a sponge, or a common silk pocket handkerchief oiled, and gradually introduced into the upper part of the vagina, should never be forgotten, as by means of it, together with the judicious employment of opium and other stimulants, many a valuable life may be saved.

In cases of syncope originating in plethora, exciting medicines should, as a general rule, be religiously abstained from, abstraction of blood being the obvious remedy. On the contrary, in the very formidable cases of fainting connected with passive dilatation of the heart, and with lesion of its valves and orifices, bloodletting is a very doubtful resource, its use requiring the greatest caution; and being suitable, when at all, rather in the intervals than during or impending the attacks: whilst in softening and atrophy of the heart it is in the strongest degree counter-indicated, the proper remedies for a sudden sense of sinking and fainting connected with these conditions being the instant exhibition of powerful cordials, hot drinks, sinapisms to the præcordial region, active friction along the spine and on the extremities, and rigid restriction to the horizontal posture. In the syncope dependent on inflammation of the heart and its membranes, stimulants would be no less misplaced than depletions under the circumstances just mentioned. In this, as well as in the other cases above enumerated, the necessity for abstaining from all strong mental emotions, and all needless muscular exertions, is self-evident.

Where a tendency to sickishness and fainting is the immediate result of a surfeit, or of something having disagreed with the stomach, the propriety of an emetic, at least where there is no counter-indication from disease of the heart or great vessels, &c., is obvious; as likewise in the case of poisoning by acrid and narcotic substances.

The syncope which is caused by a large draught of a cold fluid taken when overheated and in a state of extreme exhaustion, demands the most prompt and energetic measures. It is sometimes preceded by spasms of the stomach; and here the application of heat to the epigastrium, as by means of a bladder filled with warm water, the introduction of laudanum in a large dose into the stomach, along with hot brandy and water and other stimulants, should be had recourse to without the loss of a moment of time. If the power of swallowing is already lost, by the intervention of the stomach-pump and stimulant injections we may still make an effort to save the sufferer's life.

We have known a person to drop down insensible in the street, immediately after drinking a bottle of soda water; the seizure, however, being momentary, and not giving rise to any subsequent ill effects. In such a case we must suppose, either that the sudden distension of the stomach by the liberated gas arrests the heart's action through the medium of sympathy or pressure, or else that the obstruction of the great vessels produces a state of extreme but temporary congestion of the brain.

The rapid secretion of gas in enormous quantity into the stomach and intestines, and the consequent impediment to the motion of the diaphragm, the compression of the heart, and impairment of pulmonary dilatation, have recently been adduced to explain a case of sudden death when no other morbid appearance sufficient to account for the fatal event was discoverable on dissection; and the well-known effects of speedy gaseous distension of the abdomen, on cattle which have gorged themselves with certain green foods, countenance the explanation.

Instant death has been supposed, in cases of a different kind, to have been induced by the sudden over-distension of the cavities of the heart with blood*; and a palsied state of the organ certainly appears very rapidly to be induced in persons asphyxiated, in part by the quantity as well as by the quality of the blood with which, in consequence of the stasis in the pulmonary vessels, it soon becomes inordinately dilated.

* Leuwenhoek, quoted by Elliotson in his Physiology, p. 483.

In addition to the sources of syncope already enumerated, the spontaneous development of a gaseous fluid in the blood has been recently suggested by M. Ollivier as a possible cause of the total cessation of the heart's action; acting either mechanically by inordinate over-distension of the right side of the heart, or as a poison if it consist mostly of carbonic acid or any equally deleterious agent (*Révue Médicale*, Feb. 1838.): and he adduces a case of sudden death taking place in a debilitated patient in the effort of rising, where dissection detected nothing but the gaseous dilatation here spoken of.

As for the means to be put in practice, in the intervals of attacks of syncope, for the removal of the local and general conditions on which, when habitual they depend, we must refer the reader to what has been said in the preceding sections on the modes of strengthening and regulating the nervous, muscular, and other systems.

In connection with syncope, we may allude to cases in which the action of the heart may be enfeebled.

The action of the heart may be enfeebled in various degrees, from a momentary flutter up to actual syncope, either from want of energy in the organ or from deficient excitement, or, finally, from the embarrassment of the circulation connected with organic disease. The derangement originating in the last-named cause does not fall within the scope of the present section. That such weakness may manifest itself in a very alarming form, altogether independently of any structural lesion of the heart, is matter of every day observation: and its source may then commonly be traced up, either to the participation of the nerves of the heart in a general depression of the nervous system; or to a deficiency, sudden diminution, or impoverishment of the blood; or to sympathy of the heart with disorder in some other organ. In susceptible individuals an apparently slight cause will often suffice to induce formidable derangement of the heart's action. Thus the pulse may become not only feeble and fluttering, but of varying strength and frequency, irregular and intermitting, from a passing disorder of the stomach, or a mere flatulent distension; from the temporary oppression of the heart by too rapid an afflux of blood; or from a momentary emotion of mind, or a disagreeable impression made on the senses. Where these attacks are preceded or accompanied by a prolonged sense of faintness and anxiety, an antispasmodic or stimulant draught should be given to procure present relief, and prevent them passing into syncope; or where there is reason to suspect the presence of offending ingesta in the stomach, a mustard emetic, as best suited to clear out this organ without augmenting the debility, should be had recourse to. In their intervals the tendency to recurrence must be combated by attention to the digestive organs, by the correction of plethora or anæmia when either of these states exists, and by strictly following out the hygienic principles set forth in the last section.

ANGINA PECTORIS.

Symptoms.— Seat and Nature.— Complications.— Diagnosis.— Treatment.

This severe spasmodic affection, termed also *Syncope Anginosa*, *Sternalgia*, *Asthma Arthriticum vel Diaphragmaticum*, *Suffocative Breast-pang*, *&c.*, for the first clear account of which we are indebted to Heberden, consists in a sense of constriction in the præcordial region, and more especially under the inferior portion of the sternum, with a feeling of numbness and pain extending thence to the left arm, and is attended by apparent difficulty of breathing, intense anxiety, and apprehension of impending death.

Symptoms. It makes its appearance ordinarily, for the first time, suddenly as the person is ascending a hill, especially if the wind is in his face; or undergoing some unusual exertion soon after eating. The excessive pain and sense of suffocation and faintness oblige him, if walking, instantly to stop, and he

commonly feels as if he should die were he to persevere. By a momentary repose, his sufferings, at least towards the commencement of the disease, ordinarily vanish for the time, leaving behind only a dull aching or uneasiness within the chest. The attacks recur at uncertain intervals, at first, of weeks or months, or even still more protracted periods; but become subsequently gradually more frequent, of longer duration, and sometimes, though perhaps not generally, of greater intensity. The paroxysm is, at a more advanced period of the affection, much more easily excited; emotions of mind, intense thought, the actions of eating, coughing, or relieving the bowels, being now sufficient to bring it on. It will at this stage even occur as the individual lies at rest in his bed, and especially immediately on awaking from the first sleep; in which respect it coincides, as Heberden remarks, with many other spasmodic nervous affections.

The pain, which at first was confined to the chest and upper part of the left arm, reaching commonly only as far as the insertion of the deltoid and pectoral muscles, afterwards often extends along the ulnar nerve down the inside of the arm to the elbow, wrist, or even to the fingers. It occasionally, though rarely, affects the right arm also, the neck, and lower jaw towards the ear, causing a feeling of choking and difficulty of articulation; and may even reach, though this is much more uncommon, to the lower extremities. The pain often follows the course of the anterior thoracic nerves, more especially of the left side; and in females there is at times, from this cause, extreme tenderness of the breasts. In some anomalous cases the painful sensation has been known to originate in the arm, not being at all felt in the chest till a more advanced period of the disease.

The duration of the seizure at the commencement rarely exceeds a few minutes, though it may last for half an hour or an hour, and in the more confirmed stage of the affection the paroxysm may be still further prolonged.

The pulse is subject to great varieties, being in the slighter forms often but little affected; whilst in the protracted and more aggravated cases it is feeble, irregular, or intermittent in some, quick and strong in others; its derangements, which often continue to a certain degree in the intervals, being frequently accompanied by a marked tendency to syncope. The respiration is sometimes affected to such a degree, that the patient cannot continue in the recumbent posture: yet the difficulty of breathing, in the earlier stages more especially, is very unlike spasmodic asthma; for the patient, by an effort of the will, is still able to take a full inspiration, and sometimes finds a momentary relief from the effort. A patient of great strength of mind has been known to persist in walking, in spite of the vehemence of his sufferings; and his resolution has been rewarded by their speedy cessation. Others, again, have made a similar attempt without the like result; and we apprehend that where the attacks, as is so often the case, are connected with that excited and overloaded state of the heart induced by muscular exertion, the experiment cannot be exempt from hazard, and especially so if any organic disease exist.

The urine during the paroxysm is commonly clear and pale, as in other affections of a nervous kind, and in some rare cases it has flowed off involuntarily. Flatulence and irritability of stomach are very frequent accompaniments of the attack, the fulness of this organ adding materially to the sense of tension in the neighbourhood of the diaphragm. In the advanced stage of the disorder, the derangement of the digestive organs is a very prominent and distressing symptom at all times.

The face during the paroxysm is in general pale; and the cerebral functions are unimpaired, save in so far as the intense suffering may interfere with their exercise, or the occurrence of syncope for a time cut off the necessary supply of blood from the brain. Yet cases have been met with when, on the contrary, the action of the heart being violent, congestion of the head and convulsions took place.

Where the patient is not previously carried off suddenly by syncope in one

of the more violent seizures, as is often the case, well-marked symptoms of structural disease of the heart often eventually manifest themselves; and the scene closes amidst permanent derangement of the circulation and respiration, serous effusions, hæmorrhages, &c.

Seat and Nature. Great difference of opinion has long existed as to the true nature of this affection, some authors looking upon it as invariably connected with organic disease, whilst others view it as merely spasmodic or neuralgic, and consider any coexistent structural changes (which, they assert, are quite indeterminate in their nature) as mere coincidences, or, if connected at all, rather related as consequents than causes. Reference to the results of the numerous post-mortem examinations rec rded by various writers, shows that though organic disease of some kind or other has been found in a large proportion of cases, yet in many nothing of the kind has been detected. We are accordingly disposed to side with those who believe that angina pectoris, at least in its less inveterate modifications, may exist altogether independent of structural changes. It is only in the more aggravated and prolonged cases that such alterations have been very conspicuous. When they occur, their most frequent seat is undoubtedly in the heart, pericardium, or great vessels. Amongst the lesions which have most frequently been met with, are ossification of the valves or orifices of the heart, of the coronaries, or of the arch of the aorta; hypertrophy, dilatation or softening of the heart; excessive fatty deposition, either on this organ or in the anterior mediastinum; effusion into the pericardium or pleura; and disease and enlargement of the liver.

Being comparatively a rare disease, and consequently but few cases falling under the care of any one individual practitioner, of the numerous theories formed as to its nature and seat upon its first beginning to attract attention, most were deduced from very inadequate premises, each observer ascribing it to that particular form of organic disease in connection with which chance had most frequently presented it to him. Thus Parry, and several others in imitation of him, referred it to ossification of the coronary arteries; Fothergill to deposition of fat on the heart, and in its neighbourhood; Latham, Brera, and Zechinelli, to enlarged liver, and consequent pressure on the heart, or sympathetic derangement of its function. More enlarged observation has, however, shown, that none of these appearances are essential to its production; or, in other words, that it may exist without any of these lesions; whilst they, on the other hand, may be detected on dissection, though none of the characteristic symptoms of angina had been present during life.

Heberden, though, as we have stated, the first express writer on the subject (with the exception perhaps of Sauvages), seems to have entertained more comprehensive and just notions of its true character than the majority of those who have succeeded him. Guided rather by the well-marked morbid phenomena which characterise it during life, than by the variable and uncertain structural changes sometimes found after its fatal termination, he came to the conclusion that it was truly of a spasmodic nature. Thus the attack is ordinarily sudden in its commencement and cessation, the intervals of health being, at least at the first, perfect: mental distress often induces the paroxysm, and opiates and stimulants occasionally procure relief; there is no inflammatory quickness of pulse, and the seizures in the more advanced stage of the disease often come on, as already mentioned, after the first sleep, as is the case with many other spasmodic affections. Our best recent authorities take very similar views of its nature: thus Laennec thinks that though it often complicates organic disease, and more especially that of the heart, it is in its nature independent of it, being essentially a nervous disorder affecting primarily either the cardiac or the pneumogastric nerves, or both, according as the heart or the lungs and stomach are affected, or all three simultaneously: that the nerves of the brachial plexus become secondarily affected, as likewise the superficial cervical plexus supplying the front of the thorax; and sometimes, but much more rarely, those of the lumbar and sacral plexus, giving rise to pain in the lower extremities, and oc-

casionally to pain and swelling of the testicles. The analogy of its phenomena in diseases of acknowledged nervous origin, as sciatica and tic douloureux, is, he thinks, complete; the prominent features of each consisting in numbness and pain in the course of the nervous ramifications, with which, occasionally, slight tumefaction is associated. M. Desportes had previously advocated very similar views, save that he limited the source of the disease to the pneumogastric nerve. By M. Andral likewise it is conceived to be a mere "modification of the innervation;" occasionally indeed accompanying organic disease, but then commonly only as a subsequent complication, or, as he states it, an epiphænomenon; or else, on the other hand, obviously preceding the existence of the structural lesion, for many cases terminate fatally before any such permanent alteration has come into being. As a further evidence as to its true nature, we sometimes find it alternate with nervous affections in other parts, as with gastralgia, sciatica, tic or headach, loss of sensibility in different regions of the body, spasms of the muscles, &c. Dr. Chapman, like Desportes, conceives it to be neuralgia of the pneumogastric nerve originally, spreading subsequently to other nerves, and to those of the heart amongst the number; and supposes that the immediate cause of the irritation consists in irregular or misplaced gout, inasmuch as recovery has been frequently known to ensue on the gouty action being excited in the extremities. Dr. Butter, who with Darwin fancied the affection to be placed in the diaphragm, has likewise ascribed it, as have many other writers of repute, to a gouty source. Dr. Hossack believes it to consist in a plethoric condition, more especially of the heart and great vessels; and similar views are advanced by Dr. Forbes, in his able treatise on this affection in the *Cyclopædia of Practical Medicine.* Dr. Forbes argues that its seat must be in the heart, as well from the frequency of sudden death in the paroxysm, for which derangement of no other thoracic or abdominal organ would adequately account, as from the unquestionable frequency with which cardiac lesions are found in those who have perished by it. These lesions, it is true, are not its immediate or essential cause, which is more probably some unusual irritability of the nerves of the organ; but it is a well established general fact that diseased organs are thereby more disposed to neuralgic pains. He divides the disease into organic and functional, each of these being again subdivided into the idiopathic and sympathetic varietes. The simple functional angina he conceives to be very rare; many cases set down as such being really examples of a degree of disproportion between the cavities of the heart, which from its slightness has been overlooked. The sympathetic variety, on the contrary, or that which is called into being by the reaction of disorder in other organs, is comparatively common.

Dr. Hope thinks that any thing capable of irritating the heart, or rendering it morbid and susceptible, may suffice to produce the peculiar symptoms of angina pectoris; and hence concludes that organic disease of the heart must needs be a most influential cause. He even asserts that he never saw a very aggravated case without such organic disease. The worst cases which have fallen under his observation have been instances of osseous and cartilaginous degeneration of the heart or great vessels, and more particularly of the coronary arteries, the valves or orifices. He believes, that where the elasticity is thus impaired, any exertion which is calculated to over-distend them cannot fail to be productive of uneasy sensations, the amount of which will vary with the nervous susceptibility of the part and of the individual. In the less severe examples of the disorder he has often met with hypertrophy and dilatation, with or without softening of the heart; whereas in the mildest degree of all, which is very common in hysterical and hypochondriacal or dyspeptic patients, occurring in the form of spasmodic aching pain in the anterior part of the chest, extending sometimes to the neck and stomach, with or without pain in the arms, there has been no organic disease at all.

It has been made probable by Dr. Corrigan that several symptoms of the group which generally go under the name of angina pectoris, — paroxysms of dyspnœa induced by exercise, a sense of tearing asunder within the chest, to-

gether with anxiety and mental distress.—may originate in aortitis, or inflammation of the mouth of the aorta; which will occasionally yield, even when of rather long standing, to leeching, counter-irritation, and a mild mercurial course. M. Sormani, the editor of Testa's work, likewise seems to incline to the opinion of its being occasionally of an inflammatory, though much more frequently of an organic, nature.

No age except that of early childhood seems absolutely exempt from this disorder; in the great majority of instances, however, it does not make its incursions before the fiftieth year. Females are very much less liable to it than males in its severer form, or that accompanied with organic disease of the heart or great vessels; though in its milder grades they often suffer from it. In estimating its comparative frequency in the male and female sex we must not be guided altogether by the printed relations of cases, as it is generally only those of a more formidable character, with organic complications, which have been selected for this purpose. It is more a disease of the higher orders, who live full and take insufficient exercise, and hence have the nervous as well as the vascular system in an unhealthy state, than of the lower or labouring classes.

Complications. We have already called attention to the frequent coexistence of diseases of the heart and great vessels with this affection, and to the powerful predisposing influence they exert in regard to it. Thinness and weakness of the parietes of the heart, and disproportion in various degrees between its several cavities, are, as Dr. Forbes has very justly remarked, amongst the morbid conditions of this organ which may most readily escape observation, and which require therefore to be very carefully sought after.

Dyspepsia, in some of its varied forms, is a very common precursor and concomitant of angina pectoris, inasmuch as it reduces the tone of the nervous system, and so renders the heart as well as other parts prone to nervous disorder: and a temporary increase of the derangement of the stomach is, at the same time, no infrequent exciting cause, also, of the attacks of the disorder. Diseased enlargement of the liver, commonly a secondary affection ensuing upon long continued disorder of the stomach and bowels, may, no doubt, in its turn, both by pressure and sympathy, add still further to the existing morbid tendencies within the chest, though its importance has been greatly exaggerated by Portal, the elder Latham, and Brera.

In females, uterine and hysterical complications are not infrequent. Both excessive and deficient menstruation exert a very powerful influence in deranging sympathetically the action and nervous sensibility of the heart. But of all the complications, one of the most frequent and important is a plethoric condition of the vascular system — a state which accounts, as Dr. Forbes has remarked, for the frequent coexistence of angina with gout; its ordinary occurrence in persons at an advanced period of life, and more especially in men who indulge in luxurious living, and who, being exempt from the necessity of regular bodily labour, are prone to obesity; as well as for the striking benefit of depletion and a reduced diet in a great proportion of cases.

Diagnosis. The only disease with which angina pectoris is likely by the inexperienced to be confounded is asthma. To the mode of distinguishing them we have already alluded. It is only necessary to add here, that asthmatic attacks, from the first, manifest a preference for the evening or night; that dyspnœa, accompanied by wheezing and cough, is their prominent symptom; that there is a craving for fresh air which is quite peculiar; and, finally, a speedy remission of the symptoms on the occurrence of free expectoration,—none of which things are commonly observed in the affection we have been considering. The *prognosis* in angina pectoris depends partly on the vehemence of the symptoms, but still more on the character of the complications. In the merely functional or sympathetic cases, of hysterical or dyspeptic origin, especially where the paroxysms are not of a very aggravated nature, it is comparatively favourable, as these conditions are often within the influence of regimen and medicine, and the neuralgic pain is generally of a less obstinate character. It was probably

from particular reference to such cases that Laennec spoke of the disorder as one ordinarily of little danger. Where complicated with obvious organic disease of the heart or great vessels, and even in cases where there remains a doubt on this point, and especially if dropsical symptoms have manifested themselves, the prognosis should be a very cautious one. The known frequency of the occurrence of structural change at some period of the disease, as well as its liability to terminate in all its stages in fatal syncope, must ever cause it to be regarded as a very formidable affection.

Treatment. This is obviously divisible into two parts,— the object of the one being to give immediate relief in the paroxysm; that of the other, applicable to the intervals, to reduce the nervous irritability of the heart and of the system generally, and, where possible, to get rid of the exciting causes, and more especially of such functional derangement in other organs as is known to exercise a disturbing influence over the heart. The treatment proper, both during the seizure and subsequently, will in a considerable degree depend on the state of system in which the disorder makes its appearance. Where the patient is of a debilitated nervous habit, the use of carminatives, stimulants, antispasmodics, and anodynes are our chief resources, though unfortunately often very inadequate ones, during the paroxysm. The relief ordinarily ensuing on the expulsion of flatulence justifies the use of the first-named class of remedies. The presence of wind in the stomach will alone at times give rise to a painful sensation in the region of the heart, and even greatly derange its motions. The sense of pain and spasm in the præcordial region, over the chest and in the arm, together with the absence of all inflammatory symptoms, first suggested the use of the other classes of remedies just named. When opiates are had recourse to, they should be administered in a full dose to give them any chance of being useful. Many practitioners are, however, opposed to their employment — and perhaps with reason in such cases where there is considerable organic disease of the heart. The use of the diffusible stimulants, as ether, ammonia, or camphor,— or of antispasmodics, as castor, valerian, or assafœtida, &c.— is more universally applicable. Hydrocyanic acid, in the dose of a couple of drops, in camphor mixture, or in a solution of assafœtida, is well suited to cases connected with gastric irritation.

In cases where the action of the heart is particularly feeble, stimulant frictions to the back and chest are proper, along with sinapisms, or warm flannels impregnated with turpentine, over the præcordial region. Stimulating footbaths and maniluvia may always be had recourse to, and are peculiarly applicable to those cases where misplaced gout is suspected. A warm aperient or a terebinthinate injection should be administered in the more protracted cases, particularly where the bowels have been previously deranged; and if the stomach has been disordered by the quantity or quality of a previous meal, a mild emetic may be ventured on; or if acidity be complained of, magnesia or an alkaline ought to be given in an aromatic mixture.

In stout and plethoric patients, in whom the pulse is tolerably strong, or where if weak we have reason to think such weakness may depend on the heart and great vessels being gorged with blood, and hence unable to react freely on their contents, cautious venesection is clearly indicated, and has the sanction of Parry, Hosack, Forbes, and other practitioners of high authority. When appropriately employed, it has produced more rapid and striking relief than any other single measure whatever.

In dubious cases, cupping or leeches over the chest or back may be substituted. After the employment of depletion in cases of the kind alluded to, the other remedies mentioned above have appeared of much greater efficacy than when prematurely exhibited. When, however, there is reason to suspect, from the previous history of the case, a passive dilatation of the heart or softening of its walls, we should abstain entirely from all such depletions, as a very slight depressing cause might here suffice to arrest irretrievably the motion of the heart.

In those slighter neuralgic cases where the parietes of the chest seem chiefly implicated, dry cupping and acupuncturation are deserving of trial.

As to the treatment in the intervals, no rational plan can be formed without a correct estimate of the morbid elements present in each individual case, and more especially the recognition of organic disease where it exists, the just appreciation of associated disorder in other organs, and an accurate acquaintance with the constitution of the patient, and his habits both of mind and body. Where structural disease of the heart is ascertained as the predisposing cause of the attacks, the treatment appropriate to retarding its increase, reducing the irritability of the system, and improving the general health, of which we shall hereafter have occasion to speak, will of course constitute the most important part of the management of the case, in conjunction with the scrupulous avoidance of all the known exciting causes of the paroxysm, and more especially of all violent exertion of body, agitating passions, anxiety of mind, intense application to study or business. Many a valuable life has been instantly and prematurely terminated, like that of John Hunter, by a paroxysm of vexation, induced by some lamentably trivial and unworthy cause. The importance of a well-regulated mind, the result of constant moral discipline and of a studied system of self-control, tending to make the patient hang loose to the ordinary passing affairs of life, cannot be too strictly enforced. He should be made clearly to understand, that the prolongation of his life is, in this respect, in a manner in his own hands.

Where the disorder is purely or chiefly neuralgic, or dependent on passive enlargement or debility of the heart's structure, the use of the carbonate of iron or of the protoxide in its nascent state (a most valuable preparation*), some of the other metallic tonics, as arsenic, or the salts of zinc, silver, or copper, bark, or the sulphate of quinine, especially where the patient has been exposed to malarious influences, — together with a nutritious unstimulating diet, regular easy exercise, the enjoyment of a bracing atmosphere, and cheerful recreation of the calmer kind, — are our chief resources. Of exercises the most appropriate is that taken on horseback or in a carriage, fatigue and all undue excitement of the circulation being carefully avoided. The gentle excitement, at once of mind and body, arising from travelling by easy stages, in an interesting country, has often had a very happy influence in this as well as in so many other nervous and spasmodic affections. When the attacks are apt to take place in the night, Heberden's practice of administering an opiate at bedtime is worthy of imitation. The narcotic alcaloids, both internally and externally, have recently been much extolled; and tincture of iodine, in full doses, is recommended by Dr. Oliver, of Massachussets.

As derangement of the digestive organs so frequently complicates the other sources of this disorder, and seems not seldom in itself to be a very principal exciting as well as predisposing cause of the paroxysms, it should receive a very ample share of attention in every case where its existence, in any of its varied forms, can be detected. A temperate scale of diet, with great moderation in the use of fluids, and the scrupulous avoidance of every even occasional excess or over-distension of the stomach, together with a total abstinence from wine and other stimulants (at least in the majority of instances); the regulation of the bowels by the mildest aperients, or still better, if possible, by the quantity of the food; the early correction of acidity or other vitiated secretions; the gradual improvement of the tone of the stomach and bowels; and the speedy reduction of all irritation or inflammatory action in the liver, or any other portion of the chylopoietic viscera, — are amongst the most important points in the treatment of such cases.

A gouty or plethoric tendency requires the observance of a system of diet and regimen to be enforced with peculiar strictness; and regular exercise, which in a moderate form is proper in almost every variety of the disease, in

* For an important paper on the best mode of obtaining and administering this substance, by Mr. Donovan, see *Dublin Med. Journ.* for March 1840.

order to promote the healthy play of the functions and strengthen the nervous system, without exciting the heart, is here peculiarly called for. The cautious employment of colchicum promises to be occasionally useful; and the importance of the promotion of a free state of the bowels, with attention to the hepatic and urinary secretions, is never to be lost sight of.

Counter-irritation in the form of issues to the thighs, frequently renewed blisters between the shoulders, tartar-emetic ointment, croton oil, a seton or perpetual blister over the region of the heart or in the epigastrium, have sometimes been of peculiar service in the more chronic forms of the affection. The great benefit occasionally observed to ensue, upon the spontaneous occurrence of an hæmorrhoidal discharge, or of ulcers, or eruptions on the extremities or other parts of the body, sufficiently indicates the propriety of establishing such artificial drains or counter-irritations as have just been mentioned, and doubtless first led to their adoption. A very convenient form of establishing a purulent discharge in such cases, employed by Dr. Hutchinson, as mentioned by Dr. Copland, consists in the application to the skin of the bark of mezereon root, soaked in water and deprived of its external cuticles, and retained in contact with the skin by means of a large patch of adhesive plaster. It must be renewed for a day or two, till the purulent secretion is established, and this may subsequently be maintained for such a period as is desirable by the occasional reapplication of the bark. M. Richard, we find, mentions other species of Daphne, which, after maceration in vinegar, are similarly employed by the people in France, and some more southern countries. The application, he adds, sometimes excites an inconvenient degree of itchiness and irritation, with crops of pustules, rendering frequent tepid ablutions, with water or a decoction of marsh-mallows, necessary.

We have known a belladonna plaister over the præcordial region, renewed every week or ten days at furthest, to procure very considerable alleviation of the attacks.

Respect for the name of Laennec induces us to state, before quitting this subject, that he had great faith in the application of a couple of magnetised steel plates, one over the heart, and the other with its pole opposite to it on the back, so placed with a view to causing the magnetic current to pass directly through the suffering organ. Whether the beneficial influence of this arrangement, which he states he had frequently witnessed, was not in a greater degree dependent on the reaction of the imagination of the patient on his nervous system, than on any direct magnetic agency operating on the cardiac and associated nerves, we shall not take upon ourselves to decide. Its good effects seemed occasionally to have been much promoted, as we can well believe, by applying a small blister under the anterior plate.

NEURALGIA OF THE HEART.

Symptoms. — Nature. — Treatment.

Under this title has been described, by Dr. Elliotson and other recent authors, an acutely painful, intermittent affection of the heart, obviously of a nervous character, which seems to differ from angina more in respect to the small number of parts which are drawn into morbid consent with the suffering cardiac nerves, than in regard either to its nature or appropriate treatment. It consists in an acute lancinating pain, often of great intensity, darting through the præcordium from before backwards, and coming out under the left shoulder. It is ordinarily confined to the heart itself, the respiratory system continuing quite unaffected. Those cases in which the pain extends to the left arm and side of the neck, and still more those in which the parietes of the chest are implicated, must be referred to the head of angina.

Intermediate cases, it must be confessed, present themselves in practice and baffle classification. It is of pure neuralgia of the heart, however, that we

mean here to speak, or that condition which involves the sensitive function of the cardiac nerves alone. The sounds and motions of the organ are here commonly little or not at all affected, though this is not invariably the case. The attacks recur often, without any apparently adequate exciting cause, and, unlike angina in its early stages, even when the individual is quite at rest. The intervals are various, being sometimes only of a few hours' duration, and sometimes of many days'. Like other neuralgic affections, it occasionally manifests a tendency to periodicity; and when the acute pain of the attack has diminished, it frequently leaves behind, for a considerable time after, an uneasiness or dull aching in the region of the heart. The anguish in the more exquisite form of the disorder is, during the seizure, often quite overpowering. In its inferior grades, however, it is merely like a stitch, or crampish pain, seeming for an instant to take away the breath, and followed by a quick forced sigh or sob: in this latter degree it is by no means an uncommon occurrence, and is one apparently of little importance, being, like other pains of a nervous character, frequently merely the result of sympathy with the stomach when distended by flatulence or irritated by acidity, though at other times it seems to be connected with over-distension of the vascular system. The duration of this complaint is quite uncertain, as it sometimes continues to recur for years in spite of all treatment. It appears most frequently to originate under the influence of long-continued over-exertion of mind or anxiety acting on an irritable and nervous temperament, and is sometimes connected with a rheumatic or gouty tendency. A malarious source has been, in some cases, and apparently with reason, suspected. The upper part of the spine should in every case be carefully examined, as a very similar pain may arise from irritation or disease within the vertebral canal. The excessive use of strong tea, in certain idiosyncrasies, is occasionally, and not infrequently we believe, the unsuspected cause of acute pain in the region of the heart, together with a sense of faintness and impending syncope, of which a well-marked instance has been recorded by Dr. Edward Perceval. (*Dub. Hosp. Rep.*, vol. i.)

Treatment. Most of what has been said in respect to the treatment of angina pectoris is equally applicable to this more limited affection. As, however, it seems much less commonly to be complicated with structural disease of the heart, narcotics both externally and internally may be more freely employed, as, for example, opium in combination with camphor, or fractional doses of the narcotic alcaloids, the salts of morphia, hydrocyanic acid, &c. Ether, ammonia, and other stimulants, along with antispasmodics, may likewise be had recourse to, in order to procure relief during the paroxysm. Some of the more speedy forms of counter-irritation, as by means of mustard, ammonia, or turpentine, or the local application of heat in a degree sufficient to redden or even slightly blister the skin, in the manner alluded to in the last section, should also be immediately put in practice. In the intervals a belladonna plaster should be worn, or an ointment containing veratria employed. Where these fail, as will too often be the case, we must have recourse to some of the permanent forms of counter-irritation spoken of in a previous page, and persevere steadily in their use for a very considerable period; whilst we endeavour simultaneously to regulate the action of the bowels, and to give tone to the stomach and system generally, as it is by such means, more, perhaps, than all others put together, that the tendency to neuralgic affections is most frequently and permanently removed.

The empirical use of purgatives has, in some rare instances, been crowned with complete success; and the trial of a mild mercurial course is justifiable in cases which have resisted other methods of treatment. When a rheumatic, malarious, or gouty origin is suspected, the treatment should be modified in reference to it. Quinine, Fowler's solution, colchicum, turpentine, hydriodate of potass or of iron, the carbonate of iron, and nitrate of silver, have all severally appeared useful in different instances. The disease, however, is in many cases so obstinate, that we run through all our resources in vain, and are fain at length to resign it to its course and to the slow influences of time and

gradual change of constitution. Great temperance in food, and abstinence from all stimulant beverages, especially malt liquors, suit best with the majority of cases; some, however, have, on the contrary, gone on better on a fuller diet, and a moderate use of wine; whilst change of air, cheerful recreation, and regular exercise, have appeared beneficially applicable to all.

PERICARDITIS,

OR INFLAMMATION OF THE EXTERNAL MEMBRANE OF THE HEART.

Anatomical characters. — Symptoms. — Physical signs. — Frequency. — Chronic Pericarditis. — Duration. — Complications. — Prognosis. — Diagnosis. — Causes. — Treatment.

Inflammation of the external serous covering of the heart, and of the sero fibrous sac in which the organ is inclosed, the symptoms of which were reckoned so obscure by Corvisart and Bayle, and even by Laennec, has become, since the publication of a valuable memoir on the subject, by M. Louis, a few years ago, much better understood, more easily recognised, and consequently more susceptible of successful treatment. As some of the most important of the phenomena by which its presence is discovered are of a physical kind, and as the mode of their production cannot be comprehended without a previous knowledge of the anatomical changes in which they originate, we shall commence with an account of the morbid appearances usually characterising this affection.

Anatomical characters. Inflammation of the pericardium, like that of other serous textures, is characterised by redness, and by effusion of coagulable lymph, and of a fluid generally of a serous nature, but varying somewhat in its appearance and composition. The redness, which may depend either on injection of the capillaries, or on the effusion of blood into the subserous tissue, and the subsequent infiltration from that source of the serous membrane itself, assumes various forms, dotted or mottled, in stripes, or patches, or widely diffused. Yet sometimes, where the case has terminated fatally while the inflammation of the part was still in its nascent state, no redness has been found after death; probably rather, as in the parallel case of erysipelas, in consequence of the dilatation of the minute vessels not having been sufficiently long in existence permanently to overcome their contractility, than from the actual absence of such redness during life. The membrane itself is rarely notably changed either in respect to thickness or transparency, the appearances which have sometimes been mistaken for such alterations being really produced by the presence of a closely adhering false membrane. In the very earliest stage the serous membrane has been thought to be somewhat drier and less polished and slippery than natural; and at a more advanced period it becomes more easily detached from the heart than it should be.

The coagulable lymph, which is partly secreted in that form, and partly a deposition from the effused serum, exists in very various quantities, sometimes covering the whole pericardium in the entire of its opposed surfaces, and sometimes confined to a limited portion of it, dispersed at times in irregular masses, but more commonly expanded in a membranous form, and varying in thickness from the fraction of a line to several lines. The unattached surface of the false membrane thus originating differs somewhat in its external appearance from that observed on other serous membranes, in consequence of the perpetual movement of the contained organ and the incessant change of relation between the opposing surfaces of the pericardium. It has thus often an irregular areolated appearance, alternately compared, according to its degree of fineness or coarseness, to the reticulations of a sponge, to the cells of an honeycomb, or those in the interior of the second stomach of the cow. At other times its surface, tuberculated or studded over with slight

prominences, has caused it to be likened to the exterior of a pine-apple; or, if more jagged and irregular, to the appearance produced on separating two plates between which butter of a soft consistence had been compressed. The false membrane may present, moreover, a rough and shaggy appearance, from being thickly covered over with flocculent shreds, or when it has been some time secreted it may be arranged in undulating furrows or wrinkles. Where recently poured out, it is of a pale yellow colour and soft texture, like the buff or inflammatory crust of the blood, but becomes gradually firmer with time. Occasionally it has a reddish tinge, especially when any blood has been effused into the pericardium, and when organisation is commencing.

Sometimes it presents the appearance of a succession of layers, ascribable to the repeated recurrence of the inflammatory process; at others the whole pericardium is strewn over with minute, softish, albuminous granulations. Where the lymph is not early absorbed, adhesions commonly take place between the opposing surfaces (if not prevented by the quantity of serum present), and thus all further continuance of the morbid effusion may be prevented, and the progress of the disease arrested — too often, however, the truce is only temporary, being succeeded, in consequence of the shrinking and condensation of the organised adhesions, by subsequent limitation and embarrassment of the heart's movements, and eventually by morbid alterations in its parietes or internal structure. It is only where the early and active interposition of art, or the salutary efforts of nature have cut short the disease in its very origin, or led to the speedy absorption of the plastic matter, as well as of the accompanying liquid effusion, that both sets of evil consequences, the immediate and the remote, are with certainty escaped from. That such a result is attainable — nay, even in a great proportion of cases actually obtained — we have evidence in the frequency with which slight traces of old pericardial inflammation are met with on dissection, though no permanent disorder of the heart's action had existed during life, nor was any other alteration of its structure discoverable after death. The white spots or patches of condensed cellular membrane, so often observed on the free surface of the pericardium, and which may, with care, commonly be dissected off, are instances of such partial and passing inflammations; as are likewise those in its subserous cellular tissue, which, according to Dr. Hodgkin, are by no means of rare occurrence. Where adhesions take place, the lymph soon becomes organised and converted into cellular tissue of various degrees of firmness and condensation; and such adhesions may ensue, as has been shown by Dr. Copland, though the lymph should originally have been effused only on one of the opposing surfaces of the pericardium, as by contact the inflammatory action is soon excited on the other. The rapidity with which the process of secretion and incipient organisation occasionally takes place in pericarditis is very striking. Where the inflammation has run very high, sometimes the external surface of the sac throws out lymph, and becomes adherent to the adjacent pleuræ.

In old cases the connection between the bag of the pericardium and the heart is often very close, and it is such instances which have probably occasionally been described by the older pathologists erroneously as examples of congenital absence of this membrane. Where the agglutination takes place in an early stage of the disease, and whilst the contractions of the heart still retain a considerable portion of their vigour, the lymph, being as yet recent and ductile, is readily drawn out into long strings or loose adhesions, which do not so materially impede the future movements of the organ. The closest and most unyielding ones, on the contrary, were thought by Laennec to be peculiar to the more chronic cases of the disease; in which the adhesions were, by the presence of fluid, long prevented from taking place, so that the effused lymph had, previously to such union, acquired a considerable degree of firmness and density. This, however, is not in conformity with the experience of Dr. Hope, who thinks he has observed these intimate adhesions to be the result more frequently of the more acute forms of inflammation.

The liquid effusion of pericarditis in its earlier stages differs from that of hydropericardium, afterwards to be mentioned, in deviating more in its composition and appearance from the natural serous fluid, being a mixture of this with coagulated lymph, and sometimes with pus, or more rarely with blood. It is hence of various colours, more commonly of a pale greenish or yellowish hue, or a mixture of both, and has its transparency often considerably impaired by the flakes and shreds of coagulable lymph which float through it. If this latter substance be in a very subdivided form, it gives to the liquid a whey-like appearance, or even a milky opalescence. In respect to quantity, if unfortunately the patient's death affords an opportunity of examining the fluid within the first few days of the disease, it rarely falls short of eight or nine ounces, and has been known to amount to so much as three or four pounds. As the inflammatory action begins to diminish, the process of absorption resumes its activity, and very quickly reduces the superabundant fluid, so that the coagulable lymph now comes to predominate. In some rare cases connected with previous disorder of the general health, purulent matter is secreted from the first, and almost without any traces of coagulable lymph; but more commonly it is at a later period that the formation of pus commences, namely, in that more advanced stage of the inflammation where, from the neglect or the inadequacy of treatment, it threatens to pass into the chronic stage, and where neither the absorption of the early effusion nor yet the salutary adhesion of the plastic coating has been effected. Of thirty-seven cases analysed by Louis, the effusion was sero-sanguinolent in five, entirely serous in nine, seropurulent in fifteen, and true pus in seven. Where the tendency to suppuration predominates over that to the formation of coagulable lymph, the effused fluid is of a more uniform and creamy consistence.

Where pericarditis occurs in a chronic form, the redness is less vivid than in the acute, but the larger vascular ramifications from which the inflamed capillaries arise are commonly more developed. The long continued pressure of the effused fluid seems materially to interfere with the vigour of the heart's pulsations, the organ having from this cause often a wasted, as well as a whitish and macerated, appearance; though this is still more common in Hydrops pericardii, in which the liquid is thin and serous. Even in the chronic stage there is still a possibility of the fluid being absorbed and adhesions taking place, though the chances of such a termination are very much less considerable than in the acuter form, both on account of the nature of the effusion, the local condition of the parts, and the deeply deranged state of the general health which is commonly induced. The formation of adhesions, however, though to a certain degree protective, does not absolutely preclude the recurrence of inflammation in the false membranes; and the chronic form of the disease may from time to time give place to more acute attacks, which materially accelerate the approach of the fatal termination. In some instances, small collections of purulent matter are met with in the interstices of the adventitious membranes; and in strumous subjects they occasionally, though rarely, become the seat of tubercular deposition, just as has been observed in the parallel cases of inflammation of the peritoneum and pleuræ, occurring in connection with a scrofulous tendency.

A slight degree of thickening may take place in the pericardium from chronic inflammation: where, however, this appears to amount to any thing considerable, an attentive examination will generally show that the change is extrinsic to it, and either seated in the subserous cellular substance, which has become hypertrophied, or that it depends on the organisation of very closely adherent, equally distributed, and smooth false membranes on its secreting surface.

The false membranes of pericarditis may eventually not only become very dense cellular tissue, but even pass into a state of fibro-cartilage or bone. M. Louis has recorded a case of the latter kind where the base of the heart was surmounted by a broad osseous zone; and Burns, Laennec, Bertin, Adams, Smith, and others, have met with similar instances.

Where the quantity of organised coagulable lymph is very considerable, its effects may be, like those from the compression by a fluid, previously alluded to, to induce atrophy of the organ; but much more commonly, by exciting its action, they give rise to the very opposite condition, that of excessive nutrition and inordinate enlargement.

The inflammatory action sometimes seems to extend its influence to the superficial fibres of the heart itself, as is manifested in the softening and increased friability of the muscular tissue, its colour being either deepened into a reddish brown tint, or in more chronic cases diminished to a pallid yellowish hue. More rarely the heart undergoes an increase of density.

Symptoms. The functional derangements in these cases are variable, and, in their ordinary combinations, far from sufficient, at least without the aid of the physical signs, for the confident recognition of the disease. Amongst those most commonly present are high fever generally preceded by rigours, pain in the region of the heart, irregularity of pulse and palpitations, dyspnœa, anxiety, restlessness, and incapacity of lying on the left side, and a peculiar expression of countenance indicative of great distress. More rarely there is cough, vomiting, and difficulty of swallowing. As the disease advances there is extreme debility, suffocative paroxysms, and occasionally a tendency to syncope, with infiltrations of the face, or extremities, or both.

The blood drawn exhibits the appearances characteristic of inflammation in the highest degree, being cupped and buffed, with a very firm coagulum. The pulse in some rare cases is at first unaffected, or, according to Dr. Williams, sometimes slower than natural. The irregularity or intermission often affords the earliest notice of the impending disease, though most commonly these peculiarities of action do not manifest themselves till a more advanced period. The fever, indeed, presents itself in a great variety of forms. The pulsations at the wrist, towards the commencement more especially, are ordinarily frequent, full, strong, and regular, along with a hot and sometimes a moist skin; or they may be hard and jerking, along with violent impulse of the heart; or, again, small and wiry, and quite at variance, as it were, with the strong action going on in the præcordial region. At other times, and more especially at a somewhat advanced stage of the affection, the pulse is small and weak, uneven and irregular, the cutaneous surface being at the same time either dry and hot, or, more usually, cold and damp, especially in the extremities. The face may be flushed and swollen, or pallid, haggard, and bathed in perspiration, and expressive of intense anxiety or anguish; and when the distressing sensations reach their acme, there is often incessant jactitation, and uneasiness in every posture.

The pain in the region of the heart is increased by pressure upon or between the corresponding cartilages of the ribs, or in the epigastrium, especially when directed upwards, towards that portion of the diaphragm on which the heart rests. The pain occasionally shoots outwards towards the back, and upwards towards the shoulder, and thence into the arm to near the elbow. It is very various in intensity, being in some instances so excruciating, as in the case of the celebrated Mirabeau, as to cause the sufferer to look anxiously for death as a deliverance; whilst in others, on the contrary, it is scarcely, if at all, complained of, save whilst pressure is being made in the regions just indicated.

By very many patients the pain is referred to the epigastrium or left hypochondrium, much more than to the præcordial region. Mr. Mayne, in his admirable account of this disease, states that it existed in the first of these situations, in ten cases out of the eleven analysed by him: it was ordinarily exasperated by upward pressure, and was more circumscribed than that which occurs in connection with inflammation within the abdomen; and there was commonly less disturbance of stomach, though there were some instances where this was rather a prominent symptom. In some cases a sense of constriction all over the left side of the chest, or a feeling of weight in the region of the heart, has been complained of, rather than actual pain. Pain, in some form or other,

is certainly present in the great majority of cases.* It may be of a burning, lancinating, or a stitch-like character, as in pleurisy; and is often increased by full inspiration or coughing, as well as by extending, or lying on the left side. The decubitus on the back is generally preferred in the earlier stages. Where severe inflammation of the pleuræ, or acute rheumatism of the joints, precedes or accompanies it, the pain in the cardiac region may be so much thrown into the shade as to be readily overlooked. It was, however, in the simplest cases, that is, where there was neither pleurisy nor pneumonia, that Laennec says he had observed this symptom to be most frequently wanting; these being the instances, too, in which the affection was most apt to remain latent.

Palpitations and irregularity of the pulse are likewise amongst the more frequent symptoms; but as they are of an intermittent nature, it is often necessary, in order to detect them, to examine the patient very frequently, even within the course of a single day. They are commonly greatly exasperated by the slightest movement of the body, by coughing or speaking, and are sometimes only perceivable after such exertions. The action of the heart, which is ordinarily so vehement at the commencement, subsequently appears unusually weak when removed from contact with the chest by a profuse effusion; and its impulse is no longer confined to a single point, but may sometimes be felt in successive moments in different parts of the præcordial region.

The respiration is often short and laborious, and occasionally interrupted by sighs or hiccup, especially when the inflammation has extended to the surface of the diaphragm, in which cases likewise the risus sardonicus has sometimes been observed. The difficulty of breathing is accompanied moreover by a peculiarly deep expression of anxiety, and, when the case is very severe, and especially if a fatal termination impends, amounts to orthopnœa. Where the dyspnœa comes on suddenly, and without any discoverable disease in the lung or its lining membrane, it is a symptom of great value. "Some feeling of dyspnœa, or faintness," says Dr. Williams, "especially on moving, is the most constant symptom, and this is generally accompanied by irregularity of the pulse. The contractility of the heart, which was, in the first instance, exalted by the inflammation of its membranes, ultimately becomes impaired, the action loses its rhythm, becomes sometimes palpitating, sometimes defective, and verges on syncope." Yet the actual occurrence of syncope appears, from the researches of Louis, to be much rarer than has been commonly apprehended; and a reference to the cases recorded by Corvisart, Bertin, and Andral, proves it to be decidedly an infrequent symptom. The posture oftenest preferred by the sufferer, in the advanced stage, where the distress is extreme, is the sitting one, with the body leaning somewhat forward, or to the left side, as it were to relax the inflamed membrane.

The brain here often sympathises deeply with the derangement of the heart's functions, as is manifested by the sudden starting from sleep in affright; and at other times by the supervention of delirium and total loss of rest, and occasionally by the occurrence of spasmodic twitches, or even general attacks of convulsions. Yet such violent symptoms of reaction are by no means universal; the constitutional sympathy being sometimes incredibly slight, a very inconsiderable degree of oppression having occasionally been alone complained of.

Infiltration of the extremities is more peculiarly, though not exclusively, met with in the more chronic cases; and is often associated with a pallid or livid, and occasionally a puffy, state of the face, especially the eyelids and lips, all of which are indicative of a high degree of obstruction to the course of the circulation.

It has been remarked by M. Bouillaud that the cases of the greatest suffering, both general and local, are those of pleuritic complication, and especially where that portion of the pleuræ which lines the diaphragm is affected; and he

* Chomel, after dwelling strongly on the circumstance of pain being much more frequently absent here than in other inflammations, strangely adds that its intensity, where present, is rarely, if ever, augmented by pressure. (*Dict. de Med.*)

adds, that in those cases where there is an extreme sense of suffocation and tendency to syncope there commonly exists an abundant effusion into the pleuræ as well as into the pericardium, and sometimes also polypous concretions within the heart.

Sympathetic vomiting is one of the symptoms of nervous disturbance which sometimes makes its appearance, more especially in connection with inflammation of the upper surface of the diaphragm; and though doubtless ascribable in some instances to the vicinity of the peritonæum and stomach, to the inflamed pericardium and pleuræ, and the propagation of the inflammatory action, yet in others again it has probably its origin solely in the connection of the nerves of those parts. Pain and difficulty of swallowing, apparently also of sympathetic origin, have been noticed in a few cases by Testa and others. Dr. Stokes, who has recalled attention to this fact, adds, that he has known the same symptom to occur in connection likewise with inflammation of the lungs and pleuræ; and that aphonia, moreover, has occasionally presented itself under similar circumstances; and that he once observed very notable changes in the character of the voice to accompany the several stages of a pericarditis. He inclines strongly to the opinion that these phenomena are rather of vital than mechanical origin, inasmuch as, in the cases in which they were met with, there was no very considerable degree of effusion, nor, consequently, of pressure; whilst, on the other hand, they have been absent where the heart and lungs have been most remarkably displaced and compressed by the existence of fluid in large quantity in the pleura and pericardium simultaneously.

The great dissimilarity of the symptoms in different cases, as well as their variability in the same case, are very remarkable features of this affection, and may, in some degree, be explained by a reference to the varieties of pathological condition which exist, and more especially in regard to the effusion, its quantity and nature. Thus, as Dr. Hope and Dr. Stokes have remarked, if this consists almost wholly of coagulable lymph throughout, or if the serum thrown out have been rapidly absorbed and adhesions been early effected, the circulation will be less interfered with, and less suffering will be produced than in those other more formidable cases where there is a copious fluid effusion painfully distending the inflamed membrane, pressing upon the heart, embarrassing its motions, and inducing weakness and irregularity of the pulse, faintness, anxiety, and a sense of suffocation, along with coldness and lividity, and incapacity of assuming the recumbent posture. The supervention of such a group of symptoms at any period of a case indicates a very serious aggravation of the state of the local affection. Yet even the effusion of coagulable lymph alone, if in extraordinary quantity, may perhaps occasionally be their source; as may likewise the coming on of inflammation in the muscular substance of the heart. The degree of morbid alteration requisite in any of these cases to effect a certain amount of disturbance will, of course, vary with the nervous irritability of the individual. The cases in which the disease may be most readily altogether overlooked, are those where the effusion is confined to coagulable lymph, and where this exists only in very small quantity. (*Stokes.*)

Physical signs. The impulse of the heart at the commencement is ordinarily much augmented and abrupt, accounting for that throbbing or jerking character of the pulse which has been noticed.

The sounds are likewise increased in intensity, and, when endocarditis coexists, as is so often the case, are accompanied by a bellows-murmur. Very early in the course of the disease, as on the second or third day for instance, a faint *rubbing* or *rustling sound* (*bruit de frottement*, or to-and-fro sound—murmur of ascent and descent, &c.), such as that produced by the friction of silk-paper or parchment, is frequently audible, accompanying both sounds of the heart. This is most commonly first heard near the centre of the sternum, a little to the left of the mesial line, that is over against the base of the heart. It gradually assumes a louder, rougher character, and generally extends eventually over the whole region of the heart, and materially obscures the natural

sounds of the organ, though they may still be recognised by applying the stethoscope near the top of the sternum. It has its source in the friction of the opposed surfaces of effused lymph, which, even whilst still very thinly spread and soft, is quite sufficient for its production, as has been fully ascertained by the experiments of Drs. Williams, Clendinning, and Todd. Whether the first stage, or that of simple congestion and dryness of the membrane, be capable of giving rise to it, in a minor degree, is still doubtful: the experiments of the gentlemen just named render it, indeed, very improbable that it is ever heard except in those cases where ecchymosis under the pericardium, or some slight traces of coagulable lymph on its polished surface, already exist.

The rubbing sound occasionally somewhat changes its character, and becomes perfectly similar to the creaking of leather in the sole of a new shoe or saddle (*cris de cuir — leather creak*). This was first observed by M. Collin; and though Laennec was latterly sceptical as to its import or reality, it has since been fully confirmed as a valuable sign of pericarditis by Stokes, Reynaud, Watson, Mayne, Bouillaud, Williams, and others. Dr. Copland has likewise noticed it, but thinks that it occurs chiefly in the chronic stage of the disease, and that it is dependent on thickening and induration of the pericardium and connecting cellular membrane; or else upon the existence of a dense and elastic false membrane. Many distinguished pathologists have failed in detecting it, — probably, in part, from having confounded it with the sounds of valvular disease, and partly, as suggested by Mr. Mayne, from their not having had an opportunity of examining the cases early or frequently enough. Its whole duration sometimes does not exceed a few hours, as it is necessarily put an end to, either by the absorption of the coagulable lymph, or the formation of adhesions, or, what is more frequently the case, by the effusion of fluid in sufficient quantity to keep the opposed surfaces apart. When the formation of adhesions is the cause of its cessation, we shall probably have neither that irregularity or sinking of the pulse, nor that prostration of strength, occurring in cases of large and rapid liquid effusion; whilst, at the same time, the sound elicited by percussion is clear, and the impulse is strong. The rubbing sound will, in these cases, continue to be heard longest, as Dr. Williams suggests, towards the apex of the organ; whilst in those instances, on the contrary, where it disappears in consequence of the pouring out of an abundant quantity of fluid, it persists longest towards the base: in the latter cases, too, it may sometimes be momentarily reproduced by leaning the body forward, and so bringing the heart in contact with the anterior surface of its investing sac. This distinguished physician has known this sound to continue, in a few instances, for no less than a fortnight, in conjunction with the signs of a moderate effusion of fluid. The diminution of the heart's action, which is so conspicuous in the third stage of the disease, seems likewise to be sometimes concerned in the cessation of the sound in question, for it continues occasionally to recur at intervals with each casually stronger beat. As absorption makes progress, it has sometimes also been known to reappear. The sensation of friction is in some well-marked cases imparted very distinctly to the touch as well as to the ear.

The peculiar sound in question is commonly distinguishable from that connected with valvular disease, as Dr. Stokes many years ago pointed out, by the suddenness of its occurrence, and by the short distance from the cardiac region within which it is audible, as well as by the greater influence of treatment over it. But still there may be considerable difficulty of diagnosis where disease of the valves has pre-existed, or where endocarditis springs up simultaneously. The rubbing sound is, however, of a decidedly more superficial and equably diffused character than the bellows-murmur, indicative of disease of the valves and orifices; and is more constantly double, or an accompaniment of both motions of the heart.

The impulse of the heart decreases with the progress of the increasing effusion: the sounds likewise, both natural and morbid, become feebler and more distant, but may still be heard distinctly at the top of the sternum, or root of

the neck, in the course of the great arteries emerging from the chest, being conveyed thither through the intervening solids, and with the arterial current.

Inspection and measurement of the chest often detect, as Louis has pointed out, a fulness of the left side under the lower part of the sternum in the region of the heart, caused by the effusion within the pericardium, and partly, perhaps, also by the increased afflux of blood to the inflamed organ; and in chronic cases, or where close adhesions have taken place, by the incipient hypertrophy of its muscular parietes induced thereby. This appearance of prominence will naturally be most conspicuous in subjects of tender age, in whom the cartilages are most flexible and yielding.

Very soon after the commencement of the disease, a dull sound is elicited on percussion, in the situation just spoken of, the extent of which, as compared with the natural limits of deficiency of sound in the cardiac region formerly alluded to, very accurately defines, in simple cases, the degree of the effusion. The extent of this dulness where the quantity of fluid poured out is profuse, may be very considerable; occupying even the greater portion of the left side of the chest, and extending moreover a little to the right of the sternum. We must not, however, expect to meet with it in a marked degree, if at all, in the earliest stage of the disease, any more than the prominence above alluded to; and in those cases where the morbid secretion is limited to coagulable lymph, and that perhaps in small quantity, or where the fluid effusion is throughout very inconsiderable, the dulness may never be very obvious.

Where, however, the quantity of effusion amounts to nine or ten ounces,—and it commonly much exceeds this,—the results of percussion will be usually very important, if not altogether decisive. Our conclusions may sometimes, indeed, be embarrassed by the existence of pleurisy, or pleuro-pneumonia of the left or of both sides. When, however, these affections are confined to the right side, percussion is still capable of aiding in the recognition of pericarditis; and M. Louis has shown that in at least one half of the cases which occur it affords conclusive indications. Besides, it is to be added that the existence of dulness in the præcordial region, even though it should not be confined to that spot, is a valuable fact, inasmuch as it naturally leads to a closer investigation of the functions of the heart, and thus there is commonly disclosed sufficient evidence of pericardial inflammation where it really exists. In uncomplicated cases, again, the reality of its presence, being rendered probable by symptoms, may be confirmed materially by the disproof of all disease of the lung and its covering. If, on the contrary, the pericardial inflammation should unfortunately be masked by the predominance of an acute pulmonary affection, the error in regard to the treatment, at least, is not of very material consequence.

The sitting posture is one of those which afford the greatest facility for detecting the presence of a fluid within the pericardium: when the patient is lying on his back, on the contrary, its gravitation towards the posterior part of the chest may cause it, if small in quantity, to elude observation. The effect of the change from one to the other of these postures may assist us in discriminating pericardial effusion from a circumscribed pleuritic effusion in the same neighbourhood, tumours in the anterior mediastinum, &c. For some additional remarks on this subject, the reader is referred to what is said on percussion in the article HYDRO-PERICARDIUM.

The existence of false membranes and of adhesions after all inflammatory action has ceased is commonly very difficult of detection. The presence of the creaking or leather sound has occasionally led to their recognition; whilst a harsh grating sound has indicated a rougher or ossific state of the outer lining of the heart. Dr. Williams tells us he has sought in vain for "the jogging or tumbling motion" said by Dr. Hope to be characteristic of this restrained state of the organ; but adds, that when the inflammation has extended through to the exterior surface of the sac, and caused its agglutination to the walls of the chest, the motions of the organ become much more plainly and widely felt than usual, drawing in the intercostal spaces at each systole. The nature of the case

may sometimes also be suspected by observing that change of position has no influence over the extent in which the pulsations and the dulness on percussion are perceptible. It must be admitted, however, that a similar permanency in respect to these circumstances exists also in cases of very great enlargement of the heart.

In cases of very close adhesion, each contraction of the ventricles has been observed by Dr. Sanders to be accompanied by a corresponding retraction of the left portion of the epigastric region; and Dr. Copland has verified this symptom in two or three instances; yet it must needs be rare, or very obscure, as Laennec, Hope, Bouillaud and Chomel, have sought for it unsuccessfully.

Much difference of opinion has prevailed as to the influence of intimate adhesions on the future health, and on the action of the heart in particular. Corvisart believed that extensive adhesion necessarily deranged the motions of the heart and diaphragm so materially, as to lead sooner or later to a fatal termination; and Dr. Hope takes scarcely a more favourable view, believing that where the adhesions are close and universal the incessant struggle and over-distension of the heart, together with the alteration induced in its texture by the previous inflammatory action, tend invariably to cause enlargement of the organ, and, after an indefinite interval of a very few years death is the almost constant result. Such patients commonly labour, ever after the original attack, under a certain degree of dyspnœa and inability to undergo the same exertions as formerly. Laennec, Chomel, and Bouillaud on the contrary think such adhesions often unimportant; and Elliotson says they do not in general produce the slightest inconvenience unless where organic disease of the heart co-exists. Bouillaud believes moreover that the hypertrophy of the heart, and other formidable consequences usually ascribed to them, are referrible with much more probability to the organisation of lymph effused within the cavities of the heart, and other co-existing results of endocarditis, a disease which as is now well known often complicates pericarditis. For our part, however, it seems difficult to believe that so unnaturally shackled a condition of so mobile an organ should not very generally lead to further lesions, as it is obvious that its increased action must powerfully promote the development of any morbid tendency inherent in it. Dr. Hope has observed that the heart, though enlarged, did not in these cases beat lower in the chest than natural, but sometimes occasioned a manifest prominence of the cartilages of the left ribs, both of which circumstances result obviously from its adhesions preventing its enlargement downwards or the descent of its apex.

Chronic pericarditis is generally only the sequela of the acute variety. Occasionally, however, pericarditis assumes the chronic form from the very commencement, being unattended with any marked degree of fever, whilst the local symptoms are so mild as scarcely to attract notice. In such cases it is often altogether latent;—frequently, however, rather from attention not being particularly called to the seat of the diseased action than from the absence of sufficiently characteristic symptoms. Thus, if in addition to the physical signs indicative of effusion, as dullness on percussion, undulatory impulse, distance of the heart's sounds, and prominence of the præcordial region, there be some degree of pain or uneasiness in the situation of the heart, a slow fever with or without exacerbations in the evening, a general sense of oppression and debility, slight œdema of the face (which part is occasionally also of a violet tinge), and œdema of the ancles, we shall have reason to apprehend the existence of chronic pericarditis. The cause to which the indisposition is ascribed, as a fall or blow, acute rheumatism or inflammation within the chest, may throw further light on the nature of the affection. The comparative recentness of the disorder, which commonly does not date further back than a few weeks or months, taken in connexion with the advanced state of the dropsical symptoms, will aid us in distinguishing it from the results of old organic disease of the valves and orifices.

Frequency. Pericarditis is a disease of rather frequent occurrence. Louis

recognised its existence on an average at the rate of four per cent. of all the dissections witnessed by him within a given time.

Though an affection of the most serious nature, it is, as already stated, now ascertained to be much less commonly mortal than it was within these few years generally supposed to be. From an estimate of the number of times that traces of it are met with in the bodies of those who have died of other diseases, Chomel is led to conclude that it does not prove fatal in above a fourth (Louis says a sixth, if uncomplicated) of all the cases in which it occurs, and even these averages are probably rather over than under the truth, as they take no account of those instances, probably not very rare, in which the disease being cut short in its earliest stages, or the absorption of all effused matters being complete, no permanent traces of its existence are left behind. Of the cases in which death takes place in the course of the disease, the fatal event is ascribable, in at least one half, to co-existing complications. Where very acute, it has been known to prove fatal within thirty hours from its commencement, but this is very rare.

Its ordinary *duration*, if acute, is, unless very actively treated, from one to two weeks; or, if subacute, three or four, within which periods it terminates in death or recovery, or else begins to assume the features of the chronic stage.

The *prognosis* becomes much more unfavourable where a large effusion of fluid has taken place, and this in proportion partly to the rapidity with which it is thrown out; so, likewise, where œdematous swellings of the extremities make their appearance, where the action of the heart is greatly disturbed or oppressed, where the inner lining of the heart is deeply implicated, where there existed previous organic disease of the organ, or serious inflammatory complications, more especially in the lungs or pleuræ, and finally where the constitution has long been in a cachectic or debilitated condition

Complications. Of all these complications, especially where the disease is of rheumatic origin, which is the case perhaps in three out of every four instances, endocarditis is the most frequent. It is indeed rarely altogether absent, and is recognised by the bellows murmur and other signs to be enumerated in a subsequent section. Pericarditis seems more frequently to excite, than to ensue upon, inflammation of the interior of the heart. Pleurisy or pneumonia are present in the greater number of instances; Louis supposes in at least two thirds of the whole: carditis, or superficial inflammation of the muscular structure of the heart, and a similar condition of the cellular membrane in the anterior mediastinum of the upper surface of the diaphragm, or of the peritoneum, liver, or other abdominal organs, occasionally co-exists. The occurrence of cerebral excitement is, as we have already seen, not unusual. Pericarditis frequently makes its appearance in connexion with the eruptive fevers, and more especially with scarlatina. In childhood too it forms, no less than in adult life, a very ordinary complication of acute rheumatism, and often originates in the course of neglected convalescence from various acute diseases, especially, as Dr Copland remarks, amongst the children of the poor living in damp habitations and debilitated by insufficient nutriment.

Death by syncope is a possible but certainly rather an unusual *termination* of pericarditis. Extreme dyspnœa, amounting almost to suffocation, is, towards the conclusion, the prominent symptom in most of the fatal cases. By much the most unfavourable examples of the disease, and the least capable of bearing the requisite treatment, are those occurring in patients debilitated by previous illnesses, as fever, dropsy, &c.

Relapses are common even in cases of the disease which have been actively and judiciously treated; as is likewise the recurrence of inflammation in the membrane at periods long subsequent, and especially where the organ which it envelopes is the seat of structural change. Even adhesions do not, as commonly supposed, confer absolute immunity from future attacks; for there has often been observed by Dr. Williams and others, within the agglutinated false membranes, manifest indications of the inflammatory process, — redness, soft-

ening, recent effusion of lymph or semi-purulent fluid in small quantities in their interstices, or in the adjoining cellular membrane of the mediastinum: the physical signs of effusion, such as dullness on percussion, the rubbing sound and impaired impulse, are unfortunately wanting in these cases; they may occasionally perhaps be suspected from the existence of local pain or tenderness on pressure, or the unusual excitement or irregularity of the heart's action.

When pericarditis assumes the chronic form the prospect of recovery is much fainter; it may run on for two or three months with various alternations of improvement and aggravation, and then pass into a slow state of convalescence, or, what is but too frequently the case, may on the other hand terminate in death, which occasionally takes place suddenly and unexpectedly, though more commonly, gradually, through the mere exhaustion attendant upon continued irritation.

When the disease has lasted out some months the morbid contents of the pericardium consist most commonly either in a transparent serum, or in very thick and firm false membranes made up of many layers indicative of successive aggravations of inflammation; and in the midst of them are occasionally circumscribed purulent or tubercular deposits.

In children, with all the physical signs and symptoms of profuse pericardial effusion, we have known very remarkable recoveries to ensue, and this, on one occasion, almost solely by the unaided powers of nature.

Diagnosis. Where pericarditis exists in its simple state its diagnosis has been pronounced by Louis to be no more difficult or obscure than that of pleurisy. In at least a half of all the cases analysed by him there was during life sufficient evidence of its presence, from the union of a greater or less number of the following symptoms, — pain, or tenderness on pressure, oppression of breathing, palpitations, inequality or intermittence of the pulse, unnatural prominence, and dulness of sound over a greater extent than natural of the præcordial region, and confined to it, to which subsequent observers have added the frictional and creaking sounds already alluded to; and all these have an additional value and clearer signification, when occurring in a patient previously healthy. Most of these signs and symptoms, it is true, are met with also in water in the chest, and some of them in aneurism of the aorta; but the greater rapidity of the inflammatory affection, even if pain be absent, will generally sufficiently distinguish it.

In the course of cases of acute rheumatism of the extremities, we should ever be on the look-out for inflammation of the surfaces of the heart, and be ready to act upon the first indications of its existence, such as the sudden supervention of cardiac pain or oppression, extreme anxiety and restlessness, with notable change in the pulse and respiration; but, above all, the characteristic auscultatory phenomena, which should be sought after frequently and at very short intervals, inasmuch as they are by far the most constant signs, and often precede, by some time, the other evidences of its existence.

In pleurisy and pneumonia we should likewise be prepared for the extension of the inflammation to the heart, or its original, though it may be obscure, coexistence there. Even in the course of continued fevers, the sudden supervention of irregularity of the pulse, especially if accompanied with unusual anxiety, should direct our attention forthwith to the heart, and the possibility of its having become the seat of inflammatory action.

Bouillaud asserts, that dulness of sound, and prominence in the præcordial region, occurring along with the stethoscopic signs (rubbing and creaking sounds), and sudden fever in an individual who had previously no symptoms of organic disease of the heart, afford certain evidence of pericarditis, even though there be neither irregularity of pulse, dyspnœa, oppression, nor pain; and Dr. Hope is persuaded that even with a still smaller number of signs, namely, increased action of the heart, fever, and a murmur which did not previously exist, we may detect inflammation of this organ; and that by the nature and situation of the murmur, we may generally still further decide whether the

affection be pericarditis, endocarditis, or both. Dulness on percussion, though a valuable sign, is fortunately not indispensable, being often absent, as is still more frequently præcordial prominence. When endocarditis co-exists, as the researches of Watson, Hope, Bouillaud, and others have proved it to do in the vast majority of cases,—if it be so situated as to cause regurgitation through the aortic orifice, the pulse will be jerking, or even attended with a thrill in some cases; and we shall hear a valvular murmur coincident with the second sound of the heart. If the murmur be simultaneous with the first sound, on the other hand, impediment either in the auricular or aortic openings may be inferred. The valvular murmurs (which in themselves afford, as Dr. H. further remarks, strong presumptive evidence of pericarditis, seeing how frequently it complicates inflammation of the inner membrane), may almost always be satisfactorily distinguished from attrition murmurs by applying the stethoscope a couple of inches or more up the aorta or pulmonary artery where murmurs connected with the similunar valves will be very distinct, whilst those originating in pericardial friction will, for the most part, be inaudible; and also by searching for murmurs of the auricular valves a little above the apex of the heart, which will always be found to be their point of greatest intensity; whereas this, in respect to external murmurs, is altogether indeterminate. The attrition murmur almost invariably accompanies both sounds of the heart. In one or two instances only, Dr. H. has known it to be confined to the first sound; and in a few others, it has assumed the character of a continuous rumble, owing apparently to the churning of a small quantity of fluid, in addition to the pericardial roughness. It is ordinarily of a rough or rustling character, and more frequently accompanied by the purring tremor than are the valvular murmurs; and varies its situation and intensity with the precise seat and progress of the inflammation. Dr. Watson has recorded a case where it was unusually loud and audible over a great part of the chest; but this is very rare.

It is where the inflammatory symptoms and effusion are very slight, or where pleurisy of the left side co-exists, that the recognition of pericarditis is peculiarly difficult. A simple pleurisy of the left side might be mistaken for pericarditis, but only by a very careless observer.

The early symptomatic derangement of the cerebral functions, evinced by the coming on of delirium, stupor, &c., throws considerable difficulties in the way of the diagnosis, both by taking the attention off from the true seat of the disease, and by depriving us of a knowledge of such peculiar signs of the disease (as pain, tenderness, anxiety, sense of palpitation, &c.) as can only be ascertained through the rational consciousness of the patient; and such cases have actually been repeatedly mistaken by practitioners of the first eminence for idiopathic inflammation of the brain. Yet even here, if we have any suspicion of the true nature of the case, a recurrence to physical evidence will often clear away all obscurity.

Pleurisy and pneumonia are to be distinguished from pericarditis by their appropriate signs and symptoms detailed in another part of this work. When after an accurate investigation, we are satisfied that neither of these affections exists, this negative fact may be of great value towards the establishment of the presence of cardiac inflammation, where its local symptoms are obscure.

The sound of friction, sometimes heard in pleurisy, may usually be distinguished from that in pericarditis, by its ceasing on holding the breath. Yet it is just possible that the impulse of the heart against the lungs may at times give sufficient motion to the inflamed and coated pleuræ to produce this phenomenon; and when the diaphragmatic portion of the left pleura is its seat the diagnosis is peculiarly difficult.

An enlarged and feebly acting heart may be distinguished from the case of a profuse pericardial effusion with weak impulse and distant and indistinct sounds, by applying the stethoscope to the supra-clavicular region, where in the latter case, and in it only, the cardiac sounds will be heard with considerable clearness in the course of the carotid and subclavian arteries, indicating that

their feebleness in the præcordial region is the result of an obscured, rather than of an actually deficient action.

When the disease is accompanied with vomiting hiccup, and epigastric pain and tenderness to the touch, great general debility, with sinking and irregularity of the pulse, and cold sweats, it may readily be mistaken, if attention be not directed to the physical signs, for acute gastritis in its fatal stage.

Pericarditis in the chronic stage, accompanied with profuse effusion, has been known to push down the liver so far below the right hypochondria, as to give rise to the erroneous supposition of disease and enlargement of the latter organ. Such a case is mentioned by Mr. Adams in the Dublin Hospital Reports. In respect to diagnosis, the same author lays much stress on the distinction between the transient rheumatic affection of the heart, such as other muscular and fibrous organs are liable to, and the more serious inflammation of its serous membrane, occurring in connexion with acute rheumatism — a subject which has recently been much enlarged upon by M. Chomel.

The great variability and frequent inconsistence of the symptoms have been considered peculiarly characteristic of pericarditis, as likewise the intense restlessness, the anxious, frightened look, the early supervention of weakness and irregularity of pulse, before the general strength is proportionably reduced — the intermitting nature of this derangement, and the frequent want of correspondence between the state of the pulse and that of the skin.

Causes. In some instances it is found impossible to ascertain the *exciting* cause of this disease; certainly, however, not so frequently as Louis is disposed to think. In far the greater number it is distinctly attributable to the influence of cold, or of cold and moisture, acting on the body when overheated and fatigued, as is obvious from its ordinary connexion with rheumatic inflammation, and its frequent coincidence with pleuropneumonia, — as well as from the circumstance of its occurring more particularly during severe and changeable weather, and especially in spring. The frequency of its rheumatic origin has been recently insisted on, much and justly, by M. Bouillaud in France. This part of its history has, however, long been familiarly known to medical men in our own country. The connexion of disease of the heart with rheumatism was first noticed by Dr. Pitcairn fully half a century ago, and was soon after made more generally known to the profession by Dr. Baillie. Sir David Dundas and Dr. Wells subsequently recalled attention to it, and the latter seems with his usual penetration to have taken a just view of its inflammatory nature. Mr. Adams, in the excellent practical paper on diseases of the heart already alluded to, has dwelt particularly on the relation of pericarditis to rheumatism — yet by the French school, till very lately, all this appears to have been overlooked. Corvisart had but an obscure, or at least a very inadequate idea of the importance of the latter affection in the production of diseases of the heart; and even Louis, though so recent a writer, scarcely notices their connexion.

Bouillaud believes that at least one half of all the cases of acute rheumatism occurring in practice, or what is ordinarily called rheumatic fever, are accompanied in some part of their course by an inflammation, either of the internal or of the external lining of the heart, or both, which tends greatly to the prolongation of the illness; and that these latter affections have, in fact, in very few instances any other source. He does not, however, admit that they are so often, as is commonly supposed, the result of metastasis, but asserts that they originate in very many cases simultaneously, and proceed *pari passu* with the articular affection. We are inclined to believe, however, notwithstanding his high authority, that the instances in which the ordinarily received opinion holds good are numerous. The sero-fibrous structure of the pericardium, and of certain portions of the interior of the heart, is precisely such as should lead us to expect intimate sympathy with the inflamed synovial and ligamentous tissues of the joints. Sometimes, though rarely, the inflammation persists in an intense form, both in the heart and

joints. More commonly, however, in proportion as it becomes more violent in the one situation, it is mitigated in the other.

Cases of traumatic as well as of spontaneous erysipelas, in which the metastasis of inflammation to the heart occurred, are alluded to by Mr. Adams. They proved fatal within 48 hours, orthopnœa, great anxiety of countenance, and other symptoms of pericarditis, having supervened immediately on the disappearance of the cutaneous redness.

Though no age is exempt, yet children, and individuals about the period of puberty, are peculiarly liable to the translation of rheumatism to the pericardium; and especially in those cases where the synovial membrane is the seat of the inflammation, for, where the muscles are alone affected, metastasis is, according to the author last named, a much rarer event.

Persons of a full habit and sanguineous temperament, and in the flower of life, seem most disposed to attacks of pericarditis. The gouty and the rheumatic are peculiarly prone to it, no less than to many other forms of cardiac affection.

Convalescence from fever is frequently arrested by its supervention. It may be directly induced by external injuries, blows, falls, and penetrating wounds, and may originate also in the extension of inflammation from a neighbouring organ, more especially from the lungs and pleuræ. Continued over-exertion of body and great anxiety of mind, the suppression of habitual discharges and eruptions, the inflammatory tendencies connected with measles, small-pox, and more especially scarlet fever in its convalescent period, may also be enumerated amongst its occasional causes.

Of its *predisposing* causes little can be said with certainty. According to M. Louis the male sex is more liable to it than the female, in the proportion of three to one. The period of life between the tenth and thirtieth years appears to M. Bouillaud the most prone to it. M. Louis has noted most cases of it between the twentieth and thirtieth years, and between the sixtieth and seventieth—the periods at which, respectively, the tendency to inflammation, and to ossification and other organic changes, is most conspicuous. But the results of both these distinguished pathologists have, it must be remembered, been attained from the experience of adult-hospitals, almost exclusively. In earlier childhood it is by no means infrequent, and extreme infancy itself is not altogether exempt from it.

In respect to its very common connexion with organic disease of the heart, and especially enlargement of the organ, it exists sometimes as a cause, and sometimes as a consequence. Abuse of fermented liquors is enumerated by Dr. Elliotson amongst the sources of the insidious chronic form of pericarditis as well as of disease of the valves and orifices.

Pericarditis appears sometimes to have reigned epidemically: twenty cases once presented themselves to a single practitioner, within ten weeks, in a moderate-sized town in France. Not long since the journals contained an account of an hæmorrhagic pericarditis in Russia, of an epidemic and scorbutic character. Dr. Elliotson remarks, that the cases in which he had usually found a bloody fluid within the pericardium are those where the heart was softened.

Treatment. In the acute stage, when early seen, we should proceed instantly to the most vigorous employment of antiphlogistic remedies. Blood should be immediately taken from the arm in considerable quantity, and in a full stream; and as soon as the immediate effects of the operation have passed away, leeches in large number (twenty to forty in strong adults) are to be applied, or cupping practised over the præcordial region. If the violence of the symptoms persist, each of these measures must be repeated as freely, and at as short intervals as the age and strength of the patient permit, and as the intensity of the inflammation demands. Not a moment should be lost in thus reducing the quantity of the circulating fluid, and diminishing at once the natural stimulus of the organ, and, as far as possible, the quantity of labour to be done by it, and, at

the same time, moderating the excited action of its capillaries; for, as we have seen, if effusion in large quantity, either of coagulable lymph, or of a more fluid character — and especially the latter — has once been permitted to take place, the chances of ultimate and perfect recovery are very much impaired; and the power of the patient to bear active treatment after such an occurrence is no longer the same.

In the earliest stage of this as of many other inflammations the tartrate of antimony in large doses, as exhibited by Laennec in pleurisy, is often a valuable auxiliary to bloodletting; it is however far inferior in efficacy to the remedy next to be mentioned, and when not speedily very decisive in its effects should be at once relinquished.

If we find that in spite of the above measures, carried as far as prudence will permit, the inflammation continues to make progress, and especially if the effusion of fluid is actually commencing, no time should be lost in having recourse to the invaluable compound of calomel and opium (for the general use of which in such cases in this country the profession is indebted to Dr. Hamilton of Lynn Regis), which exercises so remarkable an influence over inflammation in serous and other analogous membranes, both checking the morbid action, and promoting the absorption of such morbid products as it may already have given rise to. Doses of from three to five grains, or upwards, of the former, guarded by from a quarter to half a grain of the latter, or an equivalent portion of Dover's powder, to prevent it running off by the bowels, should be given every fourth hour till its specific effect is manifested on the mouth, or till the disease begins to yield; and even then the mercurial is not to be suddenly relinquished, but on the contrary very gradually withdrawn, as well on account of the frequent tendency of the inflammation to recur, as lest any portion of the effused matter might still remain unabsorbed, and become the germ of ulterior disease.

Absolute repose of mind and body, and total abstinence from food, are also very important elements in the early management of these cases.

In placing bloodletting and the exhibition of mercurials so prominently forward, we are influenced by the conviction of their constituting incomparably the most essential and efficient part of the treatment. Where there is difficulty in bringing the system under the influence of mercury, in addition to its internal exhibition mercurial ointment should be introduced into the axillæ, and left there to be gradually absorbed; and at the same time fumigations with the Hydrargyr. c. Cretâ or with the mercurial candle may be practised. Amongst the auxiliary remedies are to be enumerated the promotion of moderate evacuations from the bowels, especially at the commencement of the disease, by some mild aperient, avoiding at the same time the dangerous and absurd error of trusting, like certain empirics of our day, the cure of the inflammation of so vital an organ to purgatives chiefly or alone.

When tartrate of antimony in the larger doses, alluded to above, has appeared inapplicable to the case, fractional doses of it, or of James's powder or ipecacuanha, to relax the skin and modify the inflammatory action, should be employed.

Diluent drinks in moderate quantities, to reduce the stimulant quality of the blood, without over-distending the vessels, with the addition of the nitrate of potass in as large portions as can be borne by the stomach and bowels (as, for instance, one or two scruples to the pint), are useful adjuvants in this and other analogous inflammations, especially if of rheumatic origin.

After the first vehemence of the disorder is past, and effusion has already taken place, but not on any account previously, large blisters must be applied over the seat of the inflammation, and dressed with mercurial ointment to aid in bringing the system under the desired influence of this remedy; and at the same period the employment of sedatives, as camphor, hyoscyamus, or digitalis, prussic acid, or one of the salts of morphia, may be had recourse to when the excited state of the heart, and the anxiety and restlessness continue extreme,

and seem to depend rather on a high degree of nervous irritability surviving the inflammatory action than on this latter itself.

Enveloping the chest in large emollient poultices is considered in France and Italy a measure of some efficacy; and, inasmuch as it determines locally to the skin and tends to moderate deep-seated pain, it is a point of treatment not unworthy of imitation, where no inconvenience arises from the weight of the application.

The importance of absolute repose is obvious from the fact that every the least movement, or the slightest effort, as in speaking or coughing, reproduces the irregularity of pulse, and aggravates the other symptoms.

With regard to bloodletting, it is right to state that though all practitioners are agreed as to its importance, some difference of opinion prevails as to the most effectual and safe method of employing it, and as to the extent of benefit to be expected from it. Thus M. Bouillaud, who is a great advocate for large and rapidly reiterated venesections, declares that, of late years, since he adopted this method, he has scarcely ever failed to cut short any case of pericarditis to which he was early called. He commonly takes blood three or four times from the arm, to the amount of about a pound or better each time, within the first three or four days, and employs leeches and cupping at the same time as frequently. Dr. Hope's method of employing bloodletting is very similar: blood is drawn freely from the vein by a large incision, so as to bring the patient to the verge of syncope; and this, as well as the local bleeding, is repeated twice, thrice, or oftener, at intervals of eight or twelve hours, till the pain is subdued, or as frequently as the state of the pulse, or rather the action of the heart, demands. He is however much less sanguine than the French practitioner just mentioned, as to its being adequate of itself in all cases, or even generally, to cut short the inflammation. "The antiphlogistic treatment, alone," says he, "is not to be relied on: rarely, if ever, does it in a severe case effect a complete cure." The disease too often proceeds uncontrolled by it to a fatal termination: at other times it partially yields, but the heart's action long continues of unnatural strength; and in other cases, though it may appear to have regained its healthy action, yet palpitations and symptoms of organic affection manifest themselves as soon as the patient resumes his accustomed occupations: and hence, like Dr. Latham, Elliotson, and all the best British practitioners, he has recourse early to calomel or blue pill and opium in large doses, to which occasionally mercurial inunction is superadded, or it is altogether substituted if the internal use of the medicine disagree.

Dr. Williams, whose remarks on the treatment of diseases of the heart are in general in the highest degree judicious and practical, deprecates the employment of copious venesection in inflammations of this organ, unless perhaps in their very earliest period, as he apprehends that its effect where the central organ of the circulation is primarily implicated, must be, in the first instance, to transmute the inordinate into defective action, and so to augment the embarrassment of the circulation, and keep up the feelings of dyspnœa, faintness and agitation; and, in the second place, to lay the foundation of subsequent reaction — consequences which he supposes must more readily ensue in the case of the heart in a state of inflammation than in that of any other organ. "Whether this be the true view of the case or not," he continues, "I have been convinced, by repeated observations of different kinds of practice, that both pericarditis and endocarditis, and especially if connected with rheumatism, are most safely and effectually treated by *moderate* general bloodlettings, avoiding as much as possible sudden or full impressions on the circulation; and that local bleedings, free and repeated, should in all cases be employed, as a measure of at least equal importance."

We must not, however, let the irregularity of the pulse, nor its feebleness at the wrist, nor the apparent debility of the patient, prevent us from taking blood if the complaint be still of recent origin, and the pain and other characteristic local and general symptoms seem to demand it. Young practitioners should, on the

other hand, be cautioned against being guided too much by the buffed and cupped appearance of the blood in this affection, for this, where the disease has a rheumatic origin more especially, will commonly persist in spite of the freest sanguineous evacuations, or will even augment under their use.

If unfortunately we should not be called to the case till after it has already existed for some days, and the debility of the patient is such as to render venesection hazardous, local depletion by leeches may often still be practised with great advantage. Dr. Elliotson thinks he has observed free local bleeding to be more serviceable in all cases than general, and that calomel and opium is a still more important agent than either in the subjugation of this as well as most other inflammations, and in conformity with the opinion we have already expressed, that it is far superior to the tartrate of antimony even in the large doses in which it is exhibited in Italy and France.

Colchicum also is often of decided utility, especially when the disease is of rheumatic origin, and after its first violence has been reduced. It has sometimes also proved adequate to the cure of the chronic form on persevering many months in its exhibition. When the disease has passed into the chronic stage leeches should still be occasionally employed on the revival of the pain, or other evidence of the re-excitement of the inflammatory process, and blisters must be repeatedly applied; or, at a later period, more permanent forms of counter-irritation ought to be had recourse to, as frictions with tartar-emetic ointment or croton oil, an issue or seton, or the repeated application of the moxa, a remedy in which Baron Larrey has such unbounded confidence both in respect to controlling local inflammation and producing the absorption of morbid products. In the selection and continuance of these remedies, we must of course be guided as much by their effects on the general health as by the state of the local disease, as in a prolonged affection of this kind any application which produces great irritation in the system cannot but diminish the prospect of ultimate recovery.

Counter-irritation applied to the extremities may sometimes be substituted with advantage for that in the immediate proximity of the disease. Mild mercurial courses, where they do not induce too much constitutional derangement, will generally deserve repeated trial, with a view to causing the re-absorption of remaining morbid effusions, as well as to counteract the low disorganising inflammatory process which so often survives the more active form of the disease; especially in those cases where inflammation of the interior lining, as so frequently occurs, complicates that of the exterior. The cautious exhibition of diuretics and purgatives is also frequently called for in the chronic stage. The diet should be gradually improved, but still restrained within the strictest bounds of moderation, the object being to maintain just such a degree of strength as is requisite to bear the patient through a tedious reparative process, and at the same time to avoid every thing which can accelerate the pulse or rekindle the local inflammation. Even in the most favourable cases the accustomed avocations and habits of living should not be returned to till after the lapse of a very considerable period. There is no point which should be more pressed on the mind of the patient than the absolute necessity of avoiding, for a length of time afterwards, every violent excitement of mind or body, and all excessive or prolonged muscular exertions.

When tumultuous action of the heart and other symptoms of incipient hypertrophy of the organ manifest themselves amongst the sequelæ of pericarditis, a favourite mode of treatment with M. Bouillaud is the introduction of digitalis by the endermic method, by daily sprinkling the skin, denuded of its cuticle by the previous application of a blister, with about ten grains of the substance in powder; whilst at the same time he cautions us against its use in those cases where, from the presence of a very abundant effusion of fluid or of thick masses of false membrane, there is reason to suspect a weak and atrophic state of the heart has been induced.

Turpentine, in doses sufficient to excite some degree of urinary irritation,

from its known efficacy in promoting the absorption of effused lymph, of which we have ocular demonstration in the case of iritis, is likewise deserving of trial in the chronic form of the disease, and especially in cases of rheumatic complication. The hydriodate of potass, in doses of from three to five grains and upwards, in solution thrice a day, has sometimes been administered advantageously with the same view and in the same stage of the disorder; and this substance may also at the same time be externally applied. The introduction of the alkaline subcarbonates into the patient's drinks has also been recommended as a means of promoting the action of the kidneys, favouring absorption, and modifying the composition of the blood; and is especially applicable to those cases where the urine exhibits an unnatural excess of acid, or where the blood coagulates too firmly, or other evidences of an inflammatory tendency exist. Where some degree of pain or uneasiness continues long after the primary attack, anodyne liniments or a plaster of belladonna, or an ointment containing a minute portion of veratria or aconitine, should be had recourse to as palliatives.

When in spite of the employment of the measures above indicated there is evidence of a considerable effusion persisting long after the original inflammatory attack, and when the motions of the heart appear in consequence of its pressure to be greatly deranged, the attempt to procure relief by means of a surgical operation, to be described hereafter in the article on hydrops pericardii, might possibly, in some very rare instances of chronic pericarditis, be justifiable.

Pericarditis is, as we have already seen, peculiarly apt to recur; but, fortunately, subsequent attacks are commonly very inferior in intensity to the original ones, and are much more easily controlled. Hence their treatment does not require to be by any means so energetic; nor, indeed, would the constitution be now able to sustain the same powerful antiphlogistic measures. A single moderate venesection, or local bloodletting alone, the cautious exhibition of mercury, and the employment of derivatives, are usually sufficient to check them, especially if the action of the bowels, kidnies, and skin be simultaneously promoted.

In children, even of a very tender age, pericarditis is, as already stated, by no means a remarkably rare affection, occurring most commonly in complication with rheumatism of the joints, or with pleuritic or pulmonic inflammation, or as a sequela to the febrile eruptive disorders: its treatment in such cases is to be conducted on the principles already laid down: the early and active use of antiphlogistic remedies, bloodletting, general or local, or both; calomel, with James's powder; colchicum, purgatives, diuretics, and counter-irritants, with strict confinement to bed and a very low scale of diet, constituting the chief means for its reduction. These cases go on generally much more favourably, and are more rapidly amenable to treatment than examples of the same affection in adults, and even when the effusion has already existed for several weeks its complete absorption is by no means to be despaired of.

ENDOCARDITIS,

OR INFLAMMATION OF THE INTERNAL MEMBRANE OF THE HEART.

Anatomical characters — in the acute stage — in the chronic, including DISEASES OF THE VALVES AND ORIFICES. — *Symptoms and physical signs of acute endocarditis — of chronic endocarditis, and diseases of the valves and orifices. — Causes. — Complications. — Duration. — Prognosis. — Endocarditis of children. — Treatment.*

For our present extended knowledge of the inflammation of the inner lining membrane of the heart we are chiefly indebted to M. Bouillaud, who has devoted to its consideration a large portion of his elaborate work. It had not, however, altogether escaped the notice of previous writers, as a reference to the pages of Jos. P. Frank, Hildenbrand and Kreysig, Burns and Baillie, sufficiently testifies. But it is to the distinguished French author just named that the merit is due of having set it prominently forward as an occurrence of great frequency, especially in connection with rheumatism, and as one of the most influential elements in the production of organic disease of the heart. Since he first fixed attention on it in his edition of Bertin's work published in 1824, it has been successfully investigated by several of our own countrymen, — Latham, Elliotson, Watson, Hope, &c. That it should previously have attracted so little general attention is mainly attributable to the evanescent nature of several of the morbid appearances which characterise it; for though the endocardium is allied to the serous membranes, and, like other tissues of that class, secretes, when inflamed, serum, lymph or pus, yet, from the contact of the secreted matters with the blood, they are commonly washed away by the torrent of the circulation as soon as formed, and in the greater number of instances leave no trace behind, save the slightest redness or tumefaction of the affected membrane. In some instances, however, the effused lymph seems to be of a more adhesive nature, retains its connection with the membrane on which it is formed, becomes organised, and the source of various changes of structure in the interior of the heart; especially when poured out, as is most usual, in the neighbourhood of the orifices and valves. But even independent of such ocular evidence as is obtained on dissection, we are now acquainted with certain auscultatory signs, which, taken along with the general symptoms, co-existing affections, and causes of the diseased condition, enable us to decide, even during life, with a high degree of probability as to its presence. From the researches of M. Bouillaud it appears that inflammation of the interior of the heart is at least as common as pericarditis, and is followed by still more important results; and though its early stage may not be attended with such incontestable anatomical evidences as the latter, yet those of its more advanced period are altogether analogous, and quite as satisfactory.

In the venous system, in which the circulation is comparatively slow and feeble, examples of the organisation of coagulable lymph are still more frequently observed; and the similarity of the lining membrane of the veins to that of the heart, as well as the frequent extension of inflammation from the former to the latter, should have prepared us, prior to all positive evidence, to admit the existence of idiopathic endocarditis as not improbable.

Anatomical characters. The morbid appearances characteristic of inflammation of the inner membrane of the heart are divisible into three classes: the first, or that connected with the earlier period of the affection, consisting in redness, thickening, infiltration, and softening of the membrane, along with the secretion of coagulable lymph or pus; the second, in organisation of the

effused matter, præternatural adhesion of the valves or narrowing of the orifices; and the third, in its conversion into a cartilaginous or bony tissue, and the consequent formation of permanent obstructions.

1. The redness which marks the earlier stage exhibits various degrees of intensity, from a slight blush to a deep scarlet colour, and has, in some instances, a bluish or brownish tinge. It may be either partial or general, but is commonly most evident on that portion of the membrane which lines the valves and orifices, and not rarely is entirely confined to these situations. This redness does not, for the most part, appear to consist in any very obvious capillary injection, but chiefly rather in a dyeing of the lining membrane, which, in its softened state, is, as we should expect, more prone to imbibition. The colour is not, however, removable by washing; but continued maceration will extract it. It has been doubted by Laennec and many others, whether such redness were not rather of cadaveric than of truly inflammatory origin; but the frequent co-existence of unquestionable inflammatory products induces us to suspect that scepticism has been pushed too far on this point, and to assent rather to M. Bouillaud's view of the matter, according to which this redness is, at least very frequently, the result of increased vascular action; and most probably so, when met with in bodies in which putrefaction has not yet commenced, and when the coagulability of the blood has not been remarkably impaired, as, for instance, by diseases of a putrescent or typhoid tendency, and when death has not been preceded by a very long protracted suffocative struggle.

It is not pretended that from the mere appearance of such redness we can at once safely decide on its inflammatory origin; but from the colour, taken along with a certain set of symptoms observed during life, and afterwards to be detailed, we may often arrive at such a conclusion with a high degree of probability; and this probability becomes converted into certainty, if there is found to co-exist either thickening or infiltration of the same portion of the membrane, or if purulent matter or coagulable lymph is detected, smeared over or adherent to its surface. The simultaneous presence of indubitable traces of inflammatory action in the great veins in the neighbourhood of the heart, occasionally affords an additional source of conviction as to the true nature of the appearances within this organ. It is chiefly where the case has lasted for at least two or three weeks that the redness is found to be accompanied by a thickening of the membrane, which is commonly most obvious on the valves, inasmuch as they consist of a double layer of the serous tissue, and are most frequently the points first inflamed. In many instances they have an infiltrated spongy texture, and softening of the lining membrane is often met with in the same stage; it appears also less perfectly polished than natural, and is more easily separated from the subjacent cellular tissue. Incipient ulcerations on its surface may, moreover, be occasionally detected; and these throw light on the mode in which perforation of the parietes of the organ and of its valves, afterwards to be noticed, may often take place.

The presence of purulent matter and of coagulable lymph is less frequently ascertained, they being usually, as we might expect, carried away by the passing blood as soon as formed. These substances have sometimes, however, been detected in the centre of a clot, or entangled in the meshes of the columnæ carneæ. The coagulable lymph, from its adhesive nature, the more frequently of the two retains its hold of the surface when it has been formed, and is occasionally found attached to the valves or their tendons in the form of minute granulations; and in other instances, in that of a pseudo-membranous expansion, lining a portion of the interior of the auricles and ventricles. Sometimes too, a fragment of clotted blood becomes firmly attached to the internal lining membrane, and is eventually organised.

Whether endocarditis, even in its most acute form, ever terminates in gangrene is dubious. M. Bouillaud inclines to the affirmative, in respect to those cases where, on dissection, in addition to the peculiar morbid colour, texture

and odour, indicative of this change, we find the blood unnaturally liquid or grumous, and mixed up with air bubbles; and when during life, in addition to strongly marked typhoid symptoms, there has been inordinate rapidity and irregularity of the pulse. He has not, however, adduced any very conclusive cases in evidence of his opinion.

2. Inflammation of the inner lining membrane of the heart, like that of the interior of an artery or vein, is thought by Kreysig to bestow on the contained blood a peculiar tendency to coagulation; and it has been observed that fibrinous concretions of an unusually colourless, elastic and glutinous nature, are often found in cases of acute endocarditis, adhering to the walls of the organ or to the fleshy columns or their tendons, and extending along into the great vessels. These sometimes appear to be in a state of incipient organisation, and fragments of them are not rarely attached with peculiar tenacity to the edges and base of the valves, where they constitute, in all probability, a frequent source of permanent organic disease, in the form of *vegetations* or *granulations*; though there is reason to think that these originate still more frequently in the effusion of coagulable lymph, as they are commonest in the left side of the heart, where inflammation is also most common, and where coagulation is rarest. Such appendages, which are also occasionally met with adhering to the surface of the cavities, and more especially the auricles, are divided by Laennec, in relation to their form, into the *globular* and the *warty*. The former are commonly of a softer texture, like to concrete albumen or fibrine which has as yet undergone little change, being of a dirty white or yellowish colour, with sometimes a slight tinge of red, and resemble closely those granulations often found on the surface of the pleuræ or peritonæum, when in a state of chronic inflammation. The latter are of a firmer, horny, or cartilaginous consistence, and in form not unlike venereal warts, and they adhere very strongly. Each species varies in size from that of a pin's head to a small pea; and in their number, arrangement, and form, present great differences, being sometimes isolated, and sometimes aggregated into small cauliflower excrescences; whilst individually, they are either rounded, flattened, or elongated, and in respect to their surface either smooth and polished, or rough and irregular. They rarely exist, when of old date, unaccompanied by induration of the valves and orifices, and when they are numerous and voluminous often contribute materially to obstruct the passage of blood through the latter as well as to impair the efficiency of the former. It has been remarked by Dr. Watson, that the warty vegetations on the semilunar valves affect particularly a festoon-like arrangement, being deposited in two short crescentic lines, each of which runs from the corpus sesamoideum towards the extreme point of the base of the valve, being placed some way interior to its free edge, — a line which anatomical investigation shows to correspond with the outline of the fibrous matter prolonged to a certain distance into the valve from the tendinous ring at its insertion.

There is sometimes a considerable shortening of the tendons of the auriculo-ventricular valves, quite capable of preventing their closure; and yet, when existing alone, liable to be overlooked upon a hasty examination.

The *adhesion of a valve* to the adjacent wall of the heart is a less rare occurrence than we might have expected, from the almost unremitted motion of the part and the constant contact of the blood. The valve is often in this manner so firmly glued down as to be totally incapable of fulfilling its functions, and this necessarily gives rise to great derangement of the circulation. But much the most frequent species of valvular adhesion is that which takes place between the adjacent laminæ of the valve itself, especially when the calibre of the orifice to which it is affixed, has become contracted.

Organised false membranes sometimes line a portion of one or more of the cavities of the heart, or, more rarely, form partial septa across them. The most common form in which they are met with, is that of whitish patches of a few lines in breadth on the endocardium, altogether similar to those so often seen on the exterior of the organ, and are, like them, generally easily dissected off,

leaving the membrane beneath nearly in its natural state. Apparent thickening of the endocardium is, for the most part, due to the presence of intimately adherent layers of organised lymph.

The membrane itself does, however, occasionally undergo a slight degree of hypertrophy, becoming also unnaturally opaque, and deprived of its smoothness and polish. The subserous cellular tissue, and the fibrous structure strengthening the orifices and entering into the composition of the base of the valves, very frequently participate in the hypertrophous tendency; and this holds good especially in regard to the mitral valve.

3. At a more advanced or chronic period of this affection, we find almost invariably cartilaginous or osseous induration of one or more of the valves or orifices, with irremediable contraction of the latter and serious impairment of the motion of the former. The false membrane, the original product of inflammation, thus passes in process of time through a succession of changes characterised by a gradual increase of hardness; first, assuming the form of condensed cellular membrane, and, subsequently, a cellulo-fibrous, cartilaginous, and osseous texture; the adjoining natural tissue either partaking in the morbid change, or being gradually supplanted by the new structures. The cartilaginous and calcareous deposits manifest a preference for the base and edges of the valves, and are of most various form and extent, sometimes occupying a mere point; at others, extending into flat patches or irregular protruding masses; and, in extreme cases, invading the entire substance of a valve and its tendons, or completely surrounding and greatly narrowing and obstructing an orifice. The calcareous matter in and around the fibrous zones is, in some rare cases, so profuse, as to extend deeply into the muscular substance of the heart or even to protrude on its outer surface, and thus to give rise to a loud frictional sound of a peculiarly harsh and grating character. Where the induration of the valves is very considerable, they become in a manner fixed, and quite incapable of fulfilling their office, being often, moreover, crumpled or shrivelled up, perforated, or even torn across, and hanging like a foreign substance into the cavity; but more commonly, as already stated, they become adherent by their adjacent edges; and this is most especially the case with the auriculo-ventricular valves, which may thus be seen to form an inflexible spout, as it were, projecting into the ventricle, like the rima glottidis or os tincæ in miniature; or else if flatter, an osseous partition, between the cavities, irregularly perforated in its centre, the aperture being so small in some instances as scarcely to admit the point of the little finger. Inspected from the side of the auricle, the orifice here presents a very contracted, wrinkled, or puckered appearance, and seems converted into a funnel-shaped passage. The aortic and pulmonary orifices, where their valves are similarly indurated and adherent, assume either a triangular form, or become narrowed into the shape of a buttonhole, the consolidated valves constituting thus an imperfect septum across the vessel.

The valves of the left side afford very much more frequent examples of all the above changes than those of the right, which is only in conformity with the general fact, that parts of more energetic action are more prone to morbid derangement; in addition to which, the greater abundance of fibrous tissue in the latter, as Corvisart has remarked, naturally renders them more susceptible of cartilaginous and ossific degeneration. Bichat, however, was quite in error in supposing the right side of the heart entirely exempt from such changes. According to Dr. Hope's experience, as stated in the year 1832, they are found diseased in one case out of every four or five; or, according to Dr. Latham's, in so large a proportion as one out of every three instances of induration of the left valves; but the more recent researches of the former of these writers, as well as those of Dr. Clendinning, render it now almost certain that there is a much greater disproportion than this, and that, in at least nine tenths of the cases of valvular disease, it is found on the left side alone; in somewhere about one fiftieth on the right alone; and in nearly one twentieth on both sides. The pul-

monic valve is even less frequently affected than the tricuspid. The morbid alteration detected in the valves of the right side is commonly only of a cartilaginous consistence. The tendency to contraction in the orifices of the heart, under the influence of chronic inflammation of their lining membrane, is but an additional example of what has been so often observed in respect to passages leading from various hollow organs within the body, as the urethra, for instance, the cervix of the bladder, the œsophagus, pylorus, rectum, &c. It is only in the incipient or inflammatory stage, or before such organic change has established itself, that we have any great power over these morbid processes. When they have produced the permanent effects alluded to, the walls of the hollow muscular organ, behind the narrowed passage, become ordinarily increased in thickness from the constant effort to overcome the unusual opposition to the discharge of its contents; and at the same time, from the frequent state of distention, one or more of the cavities is often much dilated. Of all the orifices the aortic seems to be the most frequently the seat of obstruction, and next to it the mitral orifice.

In persons who have died in consequence of a permanently obstructed state of the circulation through the heart, there are usually found large masses of coagula within its cavities; but these, as M. Bouillaud remarks, being soft, gelatinous, and generally tinged throughout with blood, are very unlike the firm, white, elastic, adhesive concretions of such frequent occurrence in the acute stage of endocarditis. That the cartilaginous and osseous degenerations above described, are, in the majority of cases of inflammatory origin (though this view of their nature was strenuously opposed by Laennec), has been shown to be in the highest degree probable by the researches and arguments of M. Bouillaud, who has adduced as strong proof of it, both from analogy, and from the history of the individual instances in which these appearances were met with, as the nature of the case seems to admit of. Thus chronic inflammation in other serous, sero-fibrous, and allied membranes is very commonly followed by cartilaginous or osseous deposits, as we see, for instance, in respect to the pericardium and pleuræ, the periosteum, synovial membranes and fibrous capsules of joints. The osseous deposition in question is by no means peculiar, as so often assumed, to advanced age; a great majority of the cases of it, recorded in The Clinical Treatise on Diseases of the Heart, being in patients under fifty; nearly a fourth between sixteen and thirty; one in a child of ten years, another of seven, and a third in an infant under ten months. The frequent co-existence of traces of an old pericarditis or pleurisy along with the appearances alluded to, is also certainly decidedly favourable to the inflammatory theory of their source. Besides, in a very great proportion of these cases, indubitable symptoms of inflammation within the heart have manifested themselves at some antecedent period. The *causes* in which the disease within the heart appears to have originated, as well as the influence of an antiphlogistic treatment over its progress, conspire still further to establish the fact of its being very frequently of a truly inflammatory nature; and if, in some of these instances, such inflammation is latent, or accompanied by no very well marked symptoms, this is no less incontestably the case, and that not very rarely, in regard to certain similar affections of the pleuræ and pericardium, especially when of a very chronic type, and unaccompanied by any notable effusion of fluid. Still, however, it must be admitted, many examples of it present themselves, especially in the aged, where no such source can with any probability be traced, and which seem to be connected simply with the increased tendency to osseous deposit so commonly observable in advanced life.

Symptoms. Inflammation of the interior lining of the heart commonly gives rise to a general sense of uneasiness, with a peculiar feeling of oppression and præcordial anxiety which, if carried to its highest pitch, may be accompanied by a tendency to syncope. Pain, properly so called, is, even in the acute stage of the disease, very rarely complained of; and when it does exist, seems rather

to depend on accidental complications, such more especially as pleurisy or pericarditis, than on the condition of the interior of the heart itself.

In the severer forms of the affection there are generally well marked feverish symptoms, heat and dryness of the skin, thirst, restlessness, and accelerated circulation. The character of the pulse, however, often contrasts remarkably with that of the heart's action, being small and feeble, and intermitting, even at times when the latter is most violent — a disagreement which has been ascribed by some to partial obstruction of the orifices by spasmodic contraction of the adjacent muscular fibres, but by others, on much better grounds, to mechanical impediment from congestion of the valves, effusion of lymph, or the formation of coagula within the heart; and it is at such times especially that the most formidable of the symptoms commonly ascribed to pericarditis, present themselves — extreme anxiety, jactitation, and cold sweats, pallidness and shrinking of the features, with an indefinable expression of alarm — oppressive dyspnœa, faintness, and downright syncope. Where the impediment to the circulation arrives at a great height, there is marked evidence of venous obstruction in the tumefaction and bluish colour of the lips and cheeks, and slight infiltration of hands and feet; and, apparently from the same cause, temporary convulsive seizures like epilepsy have sometimes also been observed. It is only, however, in cases where the disease exists in its intenser form, that we are to expect to meet with such well-marked general symptoms as those detailed above.* When it is very limited in extent, or when it assumes a subacute or chronic form, they are much more obscure; and were it not for the physical signs appropriate to each, the discrimination between it and pericarditis would too often be impracticable.

Physical signs. In simple endocarditis the action of the heart, as judged of by applying the hand to the chest, appears uncommonly violent, and is perceptible over an unusual surface, owing, it is supposed, to the inflammatory turgescence of the organ; and it is sometimes, moreover, accompanied by a vibratory thrill.

On percussion, during the acute stage, we occasionally discover a considerable augmentation of the extent of dullness in the præcordial region, the space in which it is now perceived being, according to Bouillaud, sometimes more than twice as great as in the natural condition. Such dullness of sound in uncomplicated cases is readily distinguished from that originating in pericardial effusion, by the beat of the heart appearing quite superficial, (a circumstance which can generally be appreciated both by the eye and by the hand), instead of being, as in the latter case, remote and indistinct, and varying remarkably with change of posture, both as to the points and in the degree in which it is felt.

It is auscultation, however, which makes known to us the existence of one of the most constant and characteristic of the phenomena of endocarditis — the *bellows-murmur* — the intensity of which increases with the vehemence and rapidity of the heart's action, and is sometimes sufficient to mask one or both of the normal sounds. When the impulse of the heart is very sharp the metallic ringing sound, already described, is occasionally audible. The frequency of the heart's pulsations is very remarkable in this disease, occasionally amounting to one hundred and fifty within the minute, or upwards; and they are often, moreover, irregular or intermittent, and of unequal force, some of them being altogether imperceptible at the wrist.

When the intensity of the inflammation has declined, the organic changes

* This affection may be anticipated, according to Dr. Hope, if a person be *suddenly* attacked, with three signs:—1. Fever; 2. Violent action of the heart; 3. A valvular murmur, which is known not to have existed previously, and is distinguishable from the attrition-murmur of pericarditis.

He believes further, that, in some rare instances, irregularity and weakness of the pulse and orthopnœa exist *temporarily*, and in a *moderate degree*, from mere disturbance of the nervous system, before any mechanical obstruction has taken place; an opinion in which we entirely concur.

left behind, provided the disease was not nipped in the bud, give rise to a new set of general and local symptoms. When the inflammation has assumed the *chronic form* (and in this it sometimes appears from the first,) the structural alterations resulting from it may be limited to simple thickening, or hypertrophy of the affected tissues, or else, as is the case in a great proportion of instances, it may give rise to their permanent induration and complete degeneracy. When *induration of the valves* and *narrowing of the orifices* have been thus produced, a permanent vibratory thrill with irregularity or intermittence, and inequality in the force of the pulsations, are very common phenomena. The contraction of the ventricles seems sometimes to be, as it were, spasmodically performed at two or three rapidly successive imperfect efforts. A greatly increased extent of dulness on percussion often co-exists, and indicates, for the most part, the complication of hypertrophy or dilatation, or of both. Auscultation almost always reveals the permanent existence of some of the varieties of unnatural murmur, of which we have spoken so much at large in the introductory observations. M. Bouillaud, out of upwards of one hundred cases of this disease examined by him, asserts that he never failed to detect the *bellows-murmur* in some of its grades, or the *rasping*, *sawing*, or *musical* sound, accompanying one or both of the normal sounds of the heart, save in one solitary instance, and that one was imperfectly examined. Pain is an occasional, but not a necessary nor even an ordinary, accompaniment of the organic changes under consideration: a sense of weight and obstruction, or an indefinable uneasiness in the region of the heart is sometimes complained of. Palpitations, characterised by a great increase of the force as well as frequency of the heart's action, along with a tendency to faintness and syncope, are very common, especially on any unusual muscular exertion, as in the act of ascending a stair or walking up a hill; and also on the occurrence of any strong mental emotion; and under these circumstances, likewise, the morbid sounds, no less than the impulse of the heart, become much more intense. In fine, when there has existed for some years, or even months, a permanent murmur accompanying the action of the heart, with or without a vibratory thrill in the pulse and præcordial region, together with frequent irregularity in the circulation, confirmed disease of the valves or orifices may be very strongly suspected; and this suspicion, according to Bouillaud, becomes changed into absolute certainty when the following general symptoms at the same time manifest themselves: namely, great contrast between the pulse at the wrist and the action of the heart; the former being very small, though commonly hard and vibrating, whilst the latter is inordinately strong; evidence of serious impediment to the course of the blood, manifested in the obstructed state of the venous circulation, — as, for example, swelling and lividity of the features, congestion of the brain, lungs, and abdominal organs, passive hæmorrhage, and serous effusions into the cellular membrane of the extremities, and into the great splanchnic cavities, and, finally, dilatation of the jugular and other large veins in the vicinity of the heart. The phenomenon of a venous pulse, synchronous with the systole of the heart, and dependent on reflux from the right ventricle, is not unfrequently observed. When the auriculo-ventricular orifice is incapable of complete closure, either from its disproportionate dilatation, or from the shrivelling, or immobility, in consequence of ossification or adhesion, of one or more of the laminæ of the tricuspid valves, the derangement of the respiratory organs, at first noticed as only a slight shortness of breath on exercise, gradually increases in intensity till, under the title of asthma, or in the form of orthopnœa, it constitutes a most prominent and distressing part of the patient's sufferings. In such a state of things, the circultation within the brain becomes eventually deeply disordered, and the sufferer, after a long-continued mortal struggle, characterised by intense anxiety, jactitation, and incessant gasping for breath, at last falls for the most part into a sub-apoplectic condition, which speedily terminates his sufferings and his life. Valvular disease becomes almost always, sooner or later, complicated with morbid alterations in the cavities of the heart, in respect to size and

strength; and the *general symptoms* of the two sets of affections are eventually interwoven together. For their further consideration, we must refer to the sections on hypertrophy and dilatation.

It is obviously much more easy to satisfy ourselves of the existence of mechanical obstruction within the heart than to determine with certainty the particular orifice in which it is seated. The difficulty to be encountered arises chiefly from the great similarity of the abnormal sounds in the several orifices when similarly diseased; from the close approximation of these apertures; and from the liability of each, when in a certain stage of morbid change, to produce a murmur under the influence of a refluent as well as of the onward current. Dr. Hope indeed believed that he had, several years ago, succeeded in discovering a series of diagnostic marks by which this difficulty might be overcome; and that too in the great majority of cases by the stethoscopic signs and pulse alone; though, at the same time, he by no means neglected the confirmatory aid of the general symptoms. Thus, disease of the *aortic valves* appeared to him to be characterised by the præternatural murmur being loudest at the middle of the sternum, and by its being of a superficial and whizzing character; accompanying the first sound of the heart, if it depended on the onward current, or the second sound, if it originated in regurgitation; in which latter case it was much feebler. Disease of the *mitral valve*, again, by the murmur being of a more hollow or distant character, and loudest opposite to the left margin of the sternum, between the third and fourth ribs; its coincidence or alternation with the pulse determining, as in the former instance, whether it depended on the direct or on the retrograde motion of the blood. Either sets of valvular murmurs might be attended with the purring tremor: it is commonest with mitral regurgitation; but it is only where it originates in the aortic orifice that it will be communicated, in the form of a thrill, to the pulse. Regurgitation was shown to be most frequent in respect to the mitral valve; being accompanied, when so situated, by a peculiarly weak and irregular pulse. Where disease existed simultaneously in both orifices, the circumstance would make itself known by the presence of each set of signs. Disease of the *pulmonic valves* is excessively rare, being seldom met with, except in cases of open foramen ovale. The apparent situation of the bellows-murmur accompanying it would be the same as in affection of the aortic valves, whilst its closeness to the ear would be still more remarkable. Induration of the *tricuspid valve*, which is likewise very uncommon, was said to be also recognisable by the site of its attending murmur, — namely, about the middle of the sternum, and a little to the right of the mesial line. These signs, he asserted, had never, for several years, deceived him as to whether there was or was not valvular obstruction; and "they have seldom failed to indicate, with perhaps more than necessary precision, the situation and nature of the affection," — provided he had first satisfied himself that the morbid sounds were not the result of nervous or hysterical excitement, anæmia, or loss of blood, cases in which they are transient and intermittent; nor of pericarditis, all other signs of such affection being absent; nor, finally, of hypertrophy, the murmur persisting in spite of repose, venesection, abstinence, and other methods of calming the heart's action. Such are the opinions expressed by Dr. Hope, in the first edition of his valuable work on diseases of the heart. Of the correctness and importance of nearly all the signs here given there can be no doubt; but it is certain that, in the hands of others, they alone were found insufficient in many cases for satisfactorily establishing the differential diagnosis of valvular disease*; and it appears to us not at all surprising that the attempt to make such distinctions, chiefly by reference to the situation of the

* This difficulty was participated in even by the most expert stethoscopists. Thus we find Dr. Graves and Dr. Stokes, so lately as September, 1838, expressing their conviction "that the physical signs of valvular disease are not yet fully established; that, taken alone, they are in no case sufficient for diagnosis; that, even in organic diseases, the nature and situation of murmurs may vary in the course of a few days; that all varieties of valvular murmurs may occur without organic disease; and, lastly, that organic disease of the valves may exist to a very great degree without any murmur whatsoever." (See *Dublin Medical Journal.*)

greatest intensity of the morbid sound,—as if this corresponded immediately to the seat of lesion,—should prove abortive, especially when we consider that the most adjacent points of some of the orifices are, as we have already seen, only a very few lines apart, and that an ordinary stethoscope may be so applied as to cover at once a portion of the whole four apertures.

A nearer approach to a successful method of establishing the diagnosis in question has been made by Dr. Williams, who is guided in a great degree by the direction in which the current, or column of the blood, (or the tense walls of the vessels?) spreads the sounds, and the different manner in which they are transmitted to the walls of the chest.* Thus, murmurs generated at the origin of the great arteries are transmitted chiefly in the direction of these tubes; whilst those produced in the auriculo-ventricular orifices are conducted at once both by the current into the ventricles, and by the chordæ tendineæ and fleshy columns to the apex of the heart, and thence to the correspondent portion of the parietes of the chest. Accordingly, in *obstructive* disease of the *aortic* orifice, the accompanying murmur, ordinarily of a sawing or grating character, and coincident with the systole, is not only audible in that part of the chest with which the heart comes into closest contact (its apex in all cases, and its body or base also, where there is great hypertrophy), but is likewise most distinctly heard along the upper half of the sternum in the direction of the inominata, and in that of the carotids, particulaly the right one. The pulse is neither weak nor irregular, unless the contraction exist in a very marked degree.

Regurgitant disease of the same orifice produces a murmur, commonly very loud, about the middle of the sternum, and which greatly obscures the second sound of the heart, especially when sought for at the top of the sternum, or in the carotids, situations in which it is in the natural condition very distinct; though it may still be sufficiently audible about the middle and left side of the sternum, where the action of the pulmonic valves is unimpaired. This murmur, in consequence of the smallness of the reflux current, is seldom so rough as the former; at times it is musical in its character, and sufficiently loud. The obstructive and the regurgitant lesions are often combined, and thus give rise to a double or to-and-fro sawing murmur. The regurgitation not unfrequently stimulates the ventricle to a second contraction, constituting a reduplication of the pulse. A very remarkable condition of the arterial circulation has been pointed out by Dr. Corrigan as characteristic of aortic reflux, in which the pulse becomes momentarily hard and full; yet, in consequence of the permanent patency of the orifice, instantaneously afterwards recedes from under the finger, and so has a jerking or thrilling character; whilst the pulsation of all the arteries is from the same cause strikingly visible, the motion in these tubes exhibiting a peculiarly wriggling or vermicular appearance, especially in the aged, in whom, having lost their dilatability, they are only capable of tortuous elongation. The value of this sign is admitted by Dr. Williams and Dr. Hope, who consider it to be almost pathognomonic of the lesion in question, when strongly marked and permanent in all conditions of the circulation.† In a slight extent it may, however, exist independent of such structural change, in consequence merely of simple excitement of the heart, especially where there is defective tension of the arterial system, as after large losses of blood, but here the pulse is invariably rapid. A new sign of inadequacy of the valves of the aorta, lately made known by Dr. Henderson, is the existence of a greatly increased interval between the systole of the heart and the pulse in the remote arteries. The musical or cooing note, taking the place of the second cardiac sound, he further asserts, is a circumstance which has hitherto only been found in cases of patency of these valves.

* In the third edition of his work on diseases of the chest, published in 1835, and more fully in his lectures, delivered in the winter of 1836, and published in the *London Medical Gazette*, in the autumn of 1838.

† It may be neutralised, as Dr. Hope remarks, by free mitral regurgitation, or great contraction, in consequence of the enfeebling effects of these lesions on the pulse.

Permanent patency of the aorta, if unaccompanied by obstruction, has, according to Dr. Hope, no systolic semilunar murmur, but only a regurgitant one.

Aortic valvular disease, though in its early stage it may only give rise to slight palpitation, shortness of breath on exercising, and præcordial uneasiness, is, when extensive, one of the most formidable of cardiac affections, and most speedily fatal. Hæmoptysis and dropsies are thought by Dr. Williams to be quite as frequent in connection with it, as in disease of the mitral valves or of the right side of the heart. There is commonly, he believes, greater restlessness and irritability, and the features are more pallid and puffy than in mitral disease, in which there is often a considerable degree of colour in the face, with greater hebetude and torpor; the symptoms in the latter being more simply those of venous congestion; but in all this there is, as he freely admits, much uncertainty.

The mitral valves appear to be much less frequently the seat of an obstructive than of a regurgitant murmur; which last, according to the author just quoted, in consequence of the facility with which the mechanism of the part is temporarily deranged by irregular action of the carneæ columnæ, &c. constitute a vast majority of the cases of bellows-sounds occurring in women and young persons under twenty years of age (in whom they are, besides, more generally of a blowing character than either grating or whistling); whilst, in older persons, and those of the opposite sex, they are more frequently caused by the diseased state of the aortic valves. On account of the interposition of the lung and right ventricle, the murmur generated in the auriculo-ventricular orifice is much less distinct immediately opposite the mitral valve than over against the apex of the heart, where it is often so loud as to obscure the natural sound; this being still audible at the upper and lower ends, and to the right of the sternum, and over the carotids. Considerable enlargement of the heart, or consolidation of the lung, may sometimes transmit the murmur more distinctly to the walls higher up; but percussion, as Dr. Williams suggests, would sufficiently elucidate the nature of the case. The pulse is generally very irregular, unequal, and weak, when there is much constriction, or free regurgitation in the mitral orifice: in the latter case, however, it has sometimes been found strong and jerking when dilated hypertrophy co-existed in a marked degree.*

The general symptoms produced by disease of the mitral valve are chiefly those of pulmonary and venous congestion, as evinced by the frequent asthmatic paroxysms and habitual dyspnœa, along with cough and an abundant expectoration occasionally tinged with blood, and by enlargement of the liver and disorder of its action, as well as of the other abdominal organs, too often mistaken, especially when the heart is as yet but slightly deranged, for idiopathic dyspepsia. There is, at the same time, a tendency to anasarca and other dropsical affections, along with headachs, giddiness, and other evidence of cerebral congestion. It is from the occasional occurrence of such a group of symptoms in a very aggravated form, that the very name of *heart-disease* carries so much terror with it; but, in reality, affections of this organ often exist, in a minor degree, without any such formidable array.

Disease of *the pulmonary valves* is so rare that Dr. Williams, though he has directed his attention so much to cardiac affections, confesses himself unable to speak of its signs from his own experience, he having never diagnosticated an instance of it during life; but he conceives that the murmurs accompanying it might be distinguished from those of the aortic valves, by not being audible at the top of the sternum nor in the carotids, as also by the circumstance of the pulse being less peculiarly affected.

* Of other causes by which irregularity and weakness of pulse may be produced, independent of valvular disease, Dr. Hope enumerates, — 1st, Softening of the heart. Here there will be no morbid murmur. 2d, Pericarditis, with copious effusion compressing the heart; endocarditis; and polypi within its cavities. Their peculiar symptoms and suddenness of supervention are diagnostic. 3d, Dyspepsia, biliousness, nervousness, gout, &c. Here the attacks are irregular, and temporary, and unattended with valvular murmur.

As to the *tricuspid* valve, he professes to be acquainted only with its regurgitant lesions, which are comparatively common, and recognisable chiefly by pulsation of the jugular veins; for the reflux here, in consequence of the natural laxity of these valves, and the inconsiderable degree of induration ordinarily present, even when diseased, is, he thinks, for the most part, unattended with any audible murmur. In a few instances, however, he has met with one of a blowing or grating character, coincident with the systolic sound, and distinctly heard from the middle to the bottom of the sternum, at the adjacent parts of the cartilages of the ribs and in the epigastrium, but not in the carotid or upper portion of the sternum.*

Adhesion of the auriculo-ventricular valves to the wall of the heart is usually accompanied by their thickening and induration, and gives rise to symptoms very similar to those attending contraction of the orifices, from which therefore it is not readily distinguishable during life; viz. palpitation, bellows-murmur, purring tremor, dyspnœa, venous congestion, and serous effusion; the reflux of blood being here equivalent to a mechanical obstruction. It is supposed by M. Bouillaud, however, that we may frequently be guided to a correct diagnosis by the bellows-sound being of a less dry and grating character in the case of simple adhesion, by the action of the heart being less irregular, by the purring tremor, if it exist, being less thrilling and more diffused, and the pulse less contracted, and, finally, by the dyspnœa, venous congestions, and serous effusions being less marked.

There are no symptoms yet known by which simple thickening of the lining membrane of the heart can be recognised; nor do the vegetations growing from it give rise to any signs by which their presence may be sus-

* Very similar views to those of Dr. Williams, detailed above, have more recently been advocated by Dr. Hope, in the *Med. Gazette*, August 4. 1838, and March 7. 1839; as well as in the new edition of his *Treatise on Diseases of the Heart*, which appeared last year. Thus the distinct audibleness of the *semilunar* murmurs for about two inches above their origin is recognised by Dr. H. as their chief characteristic, — those of the *aortic* valves being more intense towards the second intercostal space, close to the right of the sternum; those of the *pulmonary* valves, at the same level, but towards the left of this bone; whilst auricular murmurs are scarcely to be heard at this distance; and those originating in diseases of the aorta itself, besides being more acute in their pitch, are considerably louder in the tract of the vessel than immediately opposite to the semilunar valves.

It is further noticed, as confirmatory evidence of the existence of *semilunar* murmurs, that they become gradually less distinct as we descend along the tract of the ventricles; those originating in the aortic valves being, however, comparatively less faint along the course of the left ventricle; those of the pulmonic valves, along the right.

The murmur of *semilunar regurgitation*, though loudest in the site of its origin, and in some degree carried downwards by the setting in of the current in that direction, is still sufficiently distinct upwards, in the line of the great vessels respectively, and is, moreover, prolonged through the interval of repose.

The murmurs of the *auricular valves*, it is further stated, are best explored at about an inch above the apex of the heart, on the left side of the dull portion, *i. e.* about the fifth left rib, and a little within the nipple, for the *mitral* valve, and on the right side of the dull portion, at the same level, but close to the left edge of the sternum, for the *tricuspid*. At these points, the obstructive murmurs of the semilunar valves sound comparatively obscure and distant, whilst their regurgitant ones, unlike those we are now speaking of, augment in intensity as we ascend towards the orifices of the great arteries.

When both the semilunar and auricular valves are diseased, the morbid murmurs not only often differ in tone and character, but will have two distinct points of greatest intensity, up to which, respectively, we should endeavour carefully to trace them. When two murmurs have their source in the same orifice, we may recognise the fact by the circumstance of their existing in the greatest intensity at one and the same point; whilst the first coincides with the systole of the heart, the second with its diastole.

The comparative feebleness of a refluent current through the aortic and pulmonary orifices, as well as of the onward current through the auricular valves, accounts for the greater weakness of the correspondent murmurs. An obstructive mitral murmur is, of all those appertaining to the left side of the heart, one of the rarest, for the reason first mentioned; being seldom heard save in cases of very considerable narrowing of the orifice. Murmurs seated in the aortic and pulmonary orifices, from being more superficial, are in a higher key than the deeper-seated ones, connected with the mitral and tricuspid valves.

The greater or less harshness of the murmurs, and their pitch, vary with the force of the circulation, the shape and size of the orifices, and the consistency of the matter forming their contour. Where they are of a very faint character, both auscultator and patient should hold their breath, and the deepest silence be preserved. A long stethoscope should be employed, so as to render it unnecessary to stoop much; a posture which, by causing congestion of the head, interferes much with the delicacy of hearing.

pected, unless when they interfere with the action of the valves or with the caliber of the orifices; and even then they can scarcely ever be distinguished from contraction of these apertures, or from adhesion, with thickening of the valves. When they are of a very elongated form, and consequently very movable, they may probably give rise to considerable variability in respect to the period and intensity of the murmurs, causing, in one position, an obstructive, and in another, (when inserted, it may be, between the edges of the valves), a regurgitant murmur. This, together with a varying force in the current, a spasmodic state of one or more of the columnæ carneæ preventing the accurate closure of a valve, or, in some rare instances, the formation of fibrinous concretions within the cavities, are amongst the more probable causes of the occasional unsteadiness of the morbid sounds, even in the case of organic disease. The extreme disorganisation of a valve, it should be known, often gives rise to a much less intense murmur than a change, which, though much slighter, may be better calculated for the production of sonorous vibrations: the former, even though there may be no great induration, generally causes a sound of a graver, deeper, and more grating quality; those produced by the latter being commonly in a higher key, and occasionally of a musical, whistling, or cooing character. (*Williams.*)

Of the diagnosis of murmurs which are independant of organic disease, and of those connected with pericardial inflammation, from those originating in valvular lesion, we have spoken at large in former sections.

Causes. Inflammation of the interior of the heart may come on either as a primitive or as a consecutive affection: its causes, in the first instance, are essentially the same as those of pericarditis and of acute rheumatism, in union with which it so often occurs; more especially cold and moisture, or exposure to very sudden atmospheric changes, especially when the body is overheated or fatigued. Gout, intemperance, and long-continued and very fatiguing bodily exertions, hypertrophy, and nervous palpitations, predispose to it.

Complications. The disorders on which, when secondary, it most commonly ensues, are acute articular rheumatism, pericarditis, pleuro-pneumonia, and phlebitis. In respect to its connection with the first of these diseases, however, which is so very frequent, it is the opinion of Bouillaud, that it occurs very often as a cutaneous no less than as a metastatic affection. The transmission of inflammation from the pericardium to the inner lining membrane, seems to take place more frequently than from the latter to the former. Endocarditis may be excited, moreover, by sudden and prolonged embarrassment of the pulmonary circulation, such as occurs in the violent spasmodic fits of coughing of aggravated hooping-cough; by the sudden rupture of a valve in a struggle; and also, like inflammation of the veins, by the absorption of putrescent matter, or the translation of purulent collections into the torrent of the circulation.

Prognosis. It may manifest itself either in an acute, a sub-acute, or a chronic form. The prognosis to be formed in any given case of this affection depends not merely on the intensity and presumed extent of the inflammation within the heart, but also very materially on its complications, the age and strength of the patient, the period at which the treatment has been commenced, and the activity with which it has been pursued.

Duration. In its most acute form it may terminate fatally within a few days: death in such cases seems most commonly to be accelerated by the formation of extensive coagula (Polypi), within its cavities. Striking irregularity, feebleness, and frequency of the pulse, partial cold sweats, with extreme anxiety and incessant disposition to syncope, are amongst the formidable symptoms preparing us for the final catastrophe. When the disease is met by energetic measures from the commencement, it may take a favourable turn within from three or four days to a week, even though attended by the formidable complications of pleurisy or pericarditis; and the patient, under judicious management, may speedily become convalescent. Should it pass unfortunately into

the chronic form, its duration then is commonly little, comparatively, within the influence of medicine; and if the valves and orifices are very extensively implicated, it terminates, sooner or later, almost necessarily, in death; hypertrophy and dilatation of the heart, sanguineous congestions and effusions of serum or of blood, being generally first induced, and serving to accelerate the fatal event, which sometimes takes place very suddenly and unexpectedly. When, however, the lesions which have taken place are of a slighter kind, and the morbid process which has given rise to them can be arrested, life may sometimes, notwithstanding their existence, be prolonged with care, even to a very advanced period.

Endocarditis of children. According to Dr Copland, inflammation of the interior of the organ, even at a very early period of infancy, is by no means rare; presenting itself sometimes as a primary disorder; but more commonly coming on in consequence of scarlatina, small-pox or measles, pneumonia or hooping-cough, or, as in adults, in the course of acute rheumatism. When connected with the exanthemata, it is generally during the convalescence, that it makes its appearance, commencing for the most part insidiously; but soon revealing itself to the careful observer, by the frequent, feeble, and irregular pulse; tumultuous action of the heart and bellows-murmur; cough without pain or expectoration; dyspnœa on exertion, and subsequently orthopnœa; a sense of weight and oppression about the præcordium; an expression of anxiety and marked delicacy, together with feverishness in the evenings; and frequently, ere long, evidence of incipient hypertrophy and dilatation becomes quite obvious.

Treatment. It is to be treated altogether on the same principles as pericarditis; or, if any difference is to be made, it is only this, that the measures employed must be even more prompt and decided, in order to prevent the formation of coagulable lymph, or of polypous concretions within the heart, as well on account of the immediate danger attending their presence, as in regard to the ultimate risk of their becoming organised and the source of permanent obstruction. Abundant and repeated abstractions of blood, both general and local, together with the use of calomel and opium, constitute the most important part of the treatment in the most acute period. The exhibition of colchicum, or of digitalis, and the employment of counter-irritation in the shape of blisters, and in the various other forms already enumerated when speaking of the treatment of pericarditis, find a place at a somewhat more advanced stage. When it has unfortunately become chronic, either through the neglect of treatment or its inefficiency, our chief resources consist in small venesections or leechings, and absolute rest during periods of aggravation of the symptoms; adherence to a low scale of diet; the occasional employment of digitalis; the cautious induction, from time to time, of a slight mercurial action, and steady perseverance in the use of counter-irritants where the general health is not materially deranged by their employment. Such appear to be the measures most likely to arrest the disorganising process in the interior of the heart, to moderate the action of the organ, and retard the supervention of its enlargement. When organic lesions of the orifices and valves have, however, become once fully established, they admit at the most but of palliation. The support of the general health should here form a main object of attention; and the benefits arising from regulation of the digestive organs, the enjoyment of a pure atmosphere, and the gentlest exercise, studiously secured. Where dropsical symptoms have supervened, recourse must be had to the employment of diuretics and purgatives; a part of the management of these cases to which we shall have occasion to recur at a future page. Of the appropriate treatment of inflammation of the interior of the heart in children, it is unnecessary to speak particularly, it being altogether similar to that already laid down as suitable to the pericarditis of infancy.

CARDITIS,

OR INFLAMMATION OF THE MUSCULAR SUBSTANCE OF THE HEART.

Infrequency of the disease. — Authenticated cases. — Anatomical characters. — Symptoms. — Causes and treatment.

Carditis, or Inflammation of the Substance of the Heart, comprehending its muscular tissue and connecting cellular membrane, is a very rare affection, and its history as yet but imperfectly understood. Laennec has expressed his doubts as to whether there was on record a single well described case of indubitable inflammation of the whole heart: — he did not, however, deny its possibility, much less that of partial inflammation of the organ characterised by abscess and ulceration, several authentic examples of which latter are to be met with in the works of various authors as well as in his own. But even of general inflammation of the heart unquestionable instances have presented themselves, and to very competent observers. Not to speak of Meckel's case, in the *Memoirs* of the Berlin Academy for the year 1756, a very remarkable one which fell under the notice of Mr. Stanley has been described in the *Medico-chirurgical Transactions* for 1816, and has been more recently alluded to by Dr. Latham in his valuable lectures on Diseases of the Heart, he having also been present at the dissection. The subject of it — who, unfortunately, was not seen by either of these gentlemen during life, else the account of the symptoms would probably have been more satisfactory, — was a boy of twelve years of age, whose illness, obviously mistaken by the medical attendant for fever with predominating cerebral complication, terminated fatally on the fourth day. On the second day there had been pain in the left thigh and knee, doubtless of a rheumatic character, though apparently not recognised as such. Delirium supervened early, during which the only pain which could be detected on cross-questioning him was a slight one in the head. A convulsive fit occurred on the third day, and on the fourth dyspnœa and sinking. He was capable of answering questions till within a few hours of his death. It is said that the action of the pulse and of the heart was unaffected throughout; but the case, it must be remembered, occurred at a period when the examination of the state of the circulation was generally conducted in a less complete, careful, and constant manner than at present. On opening the body the pericardium was found to contain four or five ounces of turbid serum with flakes floating through it. Coagulable lymph was effused on the interior of the pericardial sac, as likewise on the exterior of the heart, which was of its natural size. "Upon cutting through its parietes, the fibres were exceedingly dark coloured, almost of a black appearance. This evidently depended on the nutrient vessels being loaded with venous blood. The fibres were also very soft and loose in their texture, being easily separable, and with facility compressed between the fingers. Upon looking closely to the cut surface exposed in the section of either ventricle, numerous collections of dark-coloured pus were visible in distinct situations among the muscular fasciculi. Some of these depositions were situated deeply near to the cavity of the ventricle; while others were more superficial, and had elevated the reflected pericardium from the heart. The muscular fibres of the auricles were also softened in their texture, and loaded with blood, but without any collections of pus between them. All the cavities of the heart were loaded with coagulated blood." No traces of inflammation were discovered within the head. Had this patient been carried off at a still earlier period of his disease it is probable that the heart would have been found merely swollen, more vascular, or of an intenser red colour than

natural. The appearances actually present prove at once the extent to which inflammation may affect the heart; and also, notwithstanding the doubts of Laennec, that softening of the muscular tissue is indubitably one of its occasional results; and it is one which we should have been prepared to expect from what has been observed in muscles elsewhere, as well as in various other organs, as the brain, lungs, liver, &c. when inflamed, friability or loss of cohesion being a very common prelude to suppuration. Another instance of carditis, of a somewhat more chronic type, was recently brought by Mr. Salter under the notice of the Medico-chirurgical Society. It ran a course of seven weeks, and began, whilst the patient was walking, by an acute pain in the left side of the chest. This recurred again about a week afterwards, whilst using the same exercise, and became subsequently very frequent, and was now induced by the slightest exertion, as even by the effort of raising the arm. When Mr. Salter first saw him, about a week before his death, there was orthopnæa, and an uneasy sensation or dull pain referred to the stomach and middle of the sternum. Notwithstanding the use of venesection, calomel, and opium, and counter-irritation, the disease proceeded unalleviated to its fatal termination. The pericardium was found inflamed, especially its diaphragmatic portion, with ecchymosed spots beneath its serous surface, and distension of its vessels. The substance of the heart was moderately firm; but the left ventricle had almost entirely lost the colour of muscle, and pus could be scraped from its surface, and in some parts there were small cavities in the muscular substance containing pus.

The heart, when in a state of softening, collapses on itself when emptied of its blood, and breaks down readily into a pulpy mass between the fingers. Its colour is various, being sometimes, as we have seen above, of a deep red, brownish or violet tinge, with occasionally a bloody fluid effused into the cellular membrane connecting the muscular fibres, or under the pericardium; or it may be of a pale or dirty white, which appears to indicate a more advanced or chronic state of inflammatory action, such as is occasionally observed in the superficial fibres of the heart in cases of chronic pericarditis with purulent effusion. It is not, however, denied that a very similar condition of the muscular substance may sometimes acknowledge other and very distinct sources. Laennec, who, as we have stated, was sceptical as to the inflammatory nature of the above-mentioned species of softening, has described another kind, characterised by its faint yellowish colour, which is very commonly confined to the deeper-seated muscular layers, and of which cachectic individuals are the chief subjects. With regard to the true nature of this variety, also, he is at issue with M. Bouillaud, who considers it, as well as the preceding, to originate in inflammation, but of a peculiarly chronic character. To Dr. Hope, who takes a middle and probably a more correct view, it has appeared to have sometimes an inflammatory, and sometimes a merely cachectic, origin.

Ulcerations of the heart have their origin almost invariably in the internal lining membrane, though, in a few instances, perhaps, they have been produced by the bursting of a purulent collection formed within the walls of the organ, and making its way to one or other of its surfaces. They are of various depths — sometimes quite superficial, and at others penetrating so deeply as to lead to the complete perforation or sudden rupture of the organ, or else to lay the foundation of a consecutive false aneurism in its walls. The consequences of perforations will vary with their situation; if they take place through the external walls, instant death, by the effusion of blood into the pericardium, is their natural and almost necessary result; whereas if they pass through the septum, their only immediate effect is the mixture of the venous and arterial currents. If the ulceration is seated in a valve, or in one of its tendons or fleshy columns, the perforation of the first, or the detachment of either of the latter, gives rise to irregular and tumultuous action of the heart, and occasionally to a rapidly fatal train of symptoms of the most distressing

nature — pain in the region of the heart, extreme anxiety, uncontrollable restlessness and impending suffocation.

Where a partial aneurism of the heart is determined in the manner above alluded to, its external surface most commonly contracts adhesions with the pericardial sac, which becomes by the irritation preternaturally thickened at the part, and this, together with the numerous layers of coagula within the tumour, tends materially to prevent its bursting, an event accordingly which rarely takes place in an early stage of the affection. Such aneurismal tumours have been met with of various sizes, from that of a nut to that of the heart itself, and often (at least of the smaller dimensions), in individuals in which their existence had been quite unsuspected during life.

Amongst the occasional consequences of inflammation of the heart must also be enumerated *induration* of the whole or a portion of the organ. That thts alteration is often of a truly inflammatory nature appears in the highest degree probable, from its frequent connection with other affections of a similar origin, as endocarditis and pericarditis. Corvisart and Laennec speak of hearts in which the muscular tissue, though of its ordinary colour, had become as hard as a dice box; and Broussais compares a heart thus indurated to a cocoa nut. This morbid alteration may, according to Bouillaud, exist in a portion of the organ, in any degree up to the actual conversion into cartilage or bone. The septum and columnæ carneæ are the parts most exempt from this change; yet some of the latter have occasionally been found extremely indurated, being converted into a yellowish white substance, like fibro-cartilaginous tissue; whilst, others, close to them, may have been, on the contrary, in a state of unnatural softness. Corvisart has given a very remarkable case in which the apex of the heart, in its whole thickness, and for some way upwards, was converted into cartilage, the columnæ carneæ of the left ventricle having nearly an equal degree of density. The disease had obviously commenced by an inflammatory attack within the chest about eighteen months before its fatal termination. M. Renauldin has related the case of a law student of thirty-three years of age, in whom the wall of the left ventricle was so penetrated with osseous particles, as were likewise the columnæ carneæ, as to resemble a petrifaction. In this case there had been, in addition to great pain on pressure, palpitations, dropsical swellings, and other ordinary symptoms of heart-disease. Mr Smith has recorded an example to which we shall again have occasion to allude more at length, of very extensive ossification on the external surface of the heart, which appeared to have commenced, as is probably commonly the case, in inflammatory false membranes formed between the two serous surfaces of the pericardium; and similar cases are to be found in Baillie, Burns, Laennec, Adams, and others. It is possible that such osseous deposition occasionally commences also, not only in the subserous cellular tissue, when in a state of chronic inflammation, but, moreover, in that connecting the muscular fibres, and comes eventually, as it increases in quantity, to encroach materially on, and eventually to displace more or less of, the muscular substance. Ossification of the whole heart is obviously impossible.

Whether *gangrene* of the heart is to be admitted amongst the possible results of its inflammation has been much disputed, it appearing to many inconceivable how life could be sustained long enough for its production in the case of an inflammation of such intensity so situated. Yet Bouillaud inclines to the affirmative; and it appears to us, that its occurrence, in a patch of limited surface and depth, is not to be rejected as beyond the limits of credibility. Corvisart thought that, like senile gangrene of other parts, it occasionally originated in a state of general debility. We are not, however, aware of any well authenticated instance of it as yet on record: most of the cases in which it has been said to exist appear obviously to have been examples of cadaveric decomposition favoured by a depraved state of the solids and fluids — such, for instance, as is met with in putrid fevers.

Inflammation of the muscular substance of the heart has probably never yet

been met with in a perfectly simple state; either pericarditis or endocarditis seeming invariably to complicate it. Corvisart was of opinion, that it for the most part assumed a very chronic character, in which, its symptoms being peculiarly obscure, it was commonly latent; and the substance of the organ, in nearly all the cases adduced by him, was of an unnaturally pale colour and soft texture. It is possible that some of the cases in which purulent deposits have been discovered within the walls of the heart, have had their origin, not in the local inflammation of this organ, but rather in the transfer of the matter, so found, from some other part of the body in a state of suppuration or abscess: and it is only by an accurate examination of the surrounding portion of its structure, and a careful consideration of previous symptoms, that a correct conclusion can be arrived at.

Many recent writers are disposed to consider *rapid hypertrophy* of the heart, also, as one amongst the forms or consequences of subacute or chronic carditis.

Symptoms of Carditis. As to the symptoms of inflammation of the substance of the heart, as distinguished from those of its lining membranes, nothing satisfactory has yet been ascertained, in consequence of its having hitherto been observed only in combination with the latter. Neither Corvisart, Laennec, nor Bouillaud, have attempted their diagnosis. The last-named author limits himself to stating his belief that the complication of acute carditis aggravates in the highest degree inflammation of the endocardium and pericardium. It has been supposed that the pain in the heart, which is augmented by pressure between the ribs and in the epigastric region, is of a peculiarly severe and lacerating or burning character, where the muscular structure is engaged; and the suffering has been said to be aggravated remarkably with each contraction of the organ. Mr. Stanley's case, however, shows that these signs are by no means universal. Greater violence of the palpitations, more marked intermissions of the pulse, which has been asserted to be generally small and weak, universal tremors, inexpressible anguish, constant jactitation, and extreme proneness to syncope, though occasionally dwelt upon as distinctive, will prove equally fallacious; being participated in, as we have seen, by very acute cases of the membranous inflammation of the organ.

It has been suspected, not without some show of probability, that the extreme rapidity of pulse in the convalescences from some fevers, especially those of an adynamic character, may be occasionally connected with an inflammatory softening of the heart. The action of the heart in the cases in question is commonly extremely feeble, both as judged of by its impulse and by its sounds, and by the great tendency to syncope; circumstances, however, which, taken alone, cannot be considered by any means decisive, as they are equally observed in cases of very abundant pericardial effusion. Recourse to the results of percussion and to the application of the stethoscope over the track of the great vessels, may sometimes enable us to decide as to the true nature of the disorder

There are no symptoms yet known by which abscess or ulceration within the walls of the heart can be certainly recognised, and the diagnosis of aneurismal tumour of the organ is no less obscure. Indeed, any of the three may exist, without exciting even a suspicion of their presence. The fatal illness of the celebrated Talma, which took place about twelve years ago, when we happened to be in Paris, and the nature of which, during his latter days, was the subject of daily conversation amongst the most distinguished of the medical professors (some of whom were in actual attendance on him), afforded a remarkable exemplification of the obscurity spoken of; for, notwithstanding the exquisite tact in diagnosis for which the French school is so justly famous, the obstruction of the bowels of which he died absorbed all attention, and the cardiac aneurism, afterwards discovered on dissection, was never, that we can recollect, even once hinted it.

It is possible, however, that percussion and auscultation may eventually put us in possession of some physical signs by which this lesion may be detected;

at least, in cases where it has attained to a considerable magnitude. Unnatural extent of dullness, and perhaps, in some instances, prominence of the præcordial region, and a thrill or a peculiar sound produced by the blood passing through the aperture of communication, are the kind of evidences which have been suggested as of probable occurrence.

Into the *causes* and *treatment* of carditis it is unnecessary to enter, as they are altogether identical with those of pericarditis and endocarditis, its usual associates, of which we have already spoken at considerable length in a former page.

HYPERTROPHY OF THE HEART.

Nature and causes. — Forms. — Anatomical characters. — Physical signs. — General symptoms. — Complications and secondary affections. — Supposed causes of each form of Hypertrophy. — Duration and prognosis. — Treatment.

Of all the affections to which the heart is liable, its *enlargement* is that which, from the obviousness of its anatomical character, the prominence of its symptoms, and the frequency of its occurrence, first attracted the attention of pathologists, and became, as it were, the type of cardiac disease. Its fatal tendency when left uncontrolled, and the variety of complications along with which it presents itself, either as a consequence, concomitant, or cause, must ever cause it to occupy a very prominent place in all treatises on disorders of the heart. It may evidently have two sources, — either augmentation of the solid matter of the heart from disproportionately increased nutrition, or expansion of its cavities, — giving rise respectively to the two denominations of *Hypertrophy* and *Dilatation*; the one being a disease of an active, the other comparatively of a passive nature. Their exciting cause is, indeed, often the same, viz. an increased demand on the exertions of the heart (from obstruction in the course of the circulation and other sources), the result varying with the vital properties of the muscular parietes of the organ, and with the general strength or debility of the system. Where the constitution is naturally robust, and the structure of the heart, in particular, is strong and well supplied with rich and stimulating blood, and its ordinary action consequently is energetic, larger demands on the exertion of the organ will be followed, according to a well known law of muscular development, (exemplified in the brawny arm of the professor of gymnastics, the fencing master, or the blacksmith, and in the lower limbs of the porter and opera dancer,) by an augmentation of bulk and power; a larger afflux of the nutritious fluid being the consequence of the constant and vigorous exercise of the part. This rule, indeed, holds good in an especial manner with respect to the heart, as the coronary arteries, by which it is fed, receive the first and fullest effects of the augmented force of the circulation.

This local increase of nutrition may soon be carried to such a length as to put the affected muscle quite out of due relation to the other parts of the system. In the case of the heart, which stands in such close connection with every portion of the body, — its condition determining in a great degree the quantity of blood which is to circulate through each part, its force and rapidity, and even the permanent increase in bulk and density of all the organs, — such an accession of power cannot fail to be often productive of very serious pathological results.

When the habit of body is, on the contrary, naturally weakly, or deeply debilitated by disease, and when the fibre of the heart itself is relaxed and yielding, and capable of little reaction, — obstruction or regurgitation, and consequent accumulation of blood, tend only to distend the walls and enlarge the cavities, without giving rise to the deposition of any proportional addition of solid material.

It was the dilatation of the heart which seems first and chiefly to have attracted

the attention of the earlier pathologists; the augmentation of its substance being commonly overlooked, or only viewed in subservience to its increased capacity. Even Corvisart, to whose clear and powerful mind we owe the removal of so many prejudices in respect to this class of diseases, was biased in the formation of his nomenclature by the prevalent error. His division of enlargements of the heart into *active* and *passive aneurism* still exerts an injurious influence on practice; for the increased efficiency of an organ, and its capability of enduring debilitating measures, is often very far from being commensurate with its increased bulk or substance. In thus massing all enlargements of this viscus under the general term of aneurism, he was guided by an erroneous analogy. Under the influence of this false generalisation, he has not only placed in a deceptive aspect some of the morbid states which he has so vividly portrayed, but been led, moreover, to overlook other pathological conditions of equally real, though less frequent occurrence. M. Bertin was the first to insist on the necessity of considering apart the thickening of the muscular parietes and the dilatation of the cavities; these being in their nature, though so often complicated together, two totally distinct morbid conditions; and also to maintain that this thickening was not ordinarily dependent on the deposition of morbid matter, as Lancisi and the older pathologists, and even Portal and other comparatively recent authorities, had asserted, but merely on an increased nutrition of the part. These juster views naturally led him to a more philosophical and correct classification, and to the recognition of forms of disease which had previously escaped notice, as well as to a more discriminating mode of treatment.

Forms. Three forms of hypertrophy of the heart are recognised by M. Bertin, — viz. the *simple*, the *excentric*, and the *concentric*. Dr. Hope's division of the varieties of hypertrophy, slightly modified from the classification of Laennec, is into *simple hypertrophy*, *hypertrophy with dilatation*, and *hypertrophy with contraction*, thus coinciding exactly in principle with that just stated; whilst the terms in which it is worded are perhaps preferable, as being simpler, and less liable to misconception. Dr. Williams also treats of the varieties of this affection under nearly the same titles, — viz. *simple*, *dilated*, and *contracted hypertrophy*.

In each there is an increase of substance in the walls of one or more of the cavities of the heart; but in the first, these cavities themselves remain of their natural size; in the second, they are enlarged; and in the third, on the contrary, diminished. This last variety, in which the deposition of new matter takes place chiefly towards the inner surface of the heart, though really less uncommon than the first or simple species, had previously altogether escaped observation. Yet the frequent existence of an analogous condition of other hollow muscular organs should have prepared us to expect it. The bulk of the heart must, however, be as large or larger than natural, at the same time that its walls seem thickened, to warrant us in asserting the presence of this variety of hypertrophy; for great contraction of the muscular fibres, such as often takes place after death, especially when somewhat sudden, the individual having been previously in vigorous health, may give rise to an appearance of thickening, which might otherwise readily be confounded with the morbid alteration in question. M. Cruveilhier, indeed, and Dr. Budd will scarcely admit the reality of concentric hypertrophy under any limitations, save as a congenital affection; believing that all the cases given as such in books either fall under the exceptional category just spoken of, or, if cardiac symptoms existed during life, were examples of simple or slightly dilated hypertrophy, with or without valvular disease; and that the shrinking of the cavity was merely a passing condition originating at or after death. In support of this view, the latter writer adduces apparent examples of this affection, in which he was able, with very slight force, to dilate the contracted cavity; and he further asserts that none of the effects usually connected with obstruction have been present, unless obstacle of some other kind, sufficient to account for them, co-existed. His arguments, at the least, prove

satisfactorily, that cases have often been mistaken for concentric hypertrophy, which had no title to the appellation.

Instances of simple hypertrophy of the heart had long since been recorded by Morgagni, Burserius, and even by Corvisart himself, but without suggesting to any of them the correcter general views with which the name of Bertin has become associated.

It seems to be the opinion of Bouillaud, that hypertrophy of the heart rarely exists unconnected with some of the other affections of the organ already enumerated; more especially with inflammation of its outer or inner linings, disease of the valves, narrowing of the orifices, or obstruction in the great vessels. The obstacle to the circulation from these lesions are, according to him, the great source of all the symptoms usually ascribed to hypertrophy. This, however, was not the opinion of Laennec, who laid much less stress on the supposed obstruction, as a cause of the derangement of the functions, than either the author just named, or even than Corvisart. Ossification of the valves, in particular, he held to be a much rarer affection than hypertrophy; and he believed, moreover, that the degree of obstruction ordinarily so produced, seldom affected the health, unless enlargement of the heart had supervened. Dr. Clendinning, too, has recently impugned the correctness of Bouillaud's views, and adduced a very great number of cases to show that hypertrophy of the heart, uncombined with any of the morbid states alluded to above, is of very frequent occurrence. Of upwards of five hundred dissections made by him of patients dying in the institution to which he is attached, where all kinds of disease, curable or incurable, are indiscriminately admitted, above one hundred and seventy — that is, about the third of the whole — proved to have had heart-disease in some form. Five sixths of these were cases of hypertrophy, uncomplicated, he assures us, with other diseases of the heart, such as pericarditis, endocarditis, or valvular disease. In about thirty cases only, or one sixth of the whole, well-marked valvular disease was detected, — combined, it is admitted, in every instance but one, with obvious hypertrophy. Dr. Hope, while he fully admits, with Bouillaud, that valvular disease is a very frequent cause of hypertrophy and dilatation, yet agrees with Dr. Clendinning in considering the alteration in the muscular structure of the organ as the chief element in the production of the distressing symptoms; inasmuch as, commonly, it is not until this latter has been superinduced, that the embarrassment of the circulation and the patient's sufferings become very considerable, and it is, moreover, chiefly on the prevention or treatment of these abnormal muscular conditions that our hopes of alleviation are based in the advanced stages of valvular lesion.

The normal average weight of the heart, in the male subject, as we have seen, is estimated by Dr. Clendinning at about nine ounces.* In several cases, hypertrophy was proved, by recourse to the balance, to exist, though it was not obvious to the eye, — as, for instance, when the heart weighed about eleven or twelve ounces. The average weight of eighty diseased hearts of males was, however, much more than this, — namely, fifteen ounces, or two fifths more than the healthy standard. Even where diseased valves and hypertrophy co-exist, Dr. Clendinning sees no proof of the antecedence of the former. His belief is, that the hypertrophy results exclusively from vital and not from mechanical causes, and is in its turn the source of an augmented tendency to inflammation throughout the body generally, and in the heart itself no less than in other parts; and that the valsular lesion, in conformity with this view, is often the consequence rather than the cause of hypertrophy. "I would thus," he continues, "in a great degree, reverse the order of causation usually received, and attribute much of the valvular disease to inflammation, mainly induced (if rheumatism be excluded) by previous hypertrophy as a most potent predisposing cause." To this opinion

* The natural average weight of the heart varies with the age. Thus, in the prime of life, it falls slightly below the weight stated in the text, whilst, in old age, it may exceed it by half an ounce or so.

he has been led, by observing that, in the great majority of cases of morbus cordis, no valvular disease exists; whilst, on the other hand, he has never but once met with this last-named lesion, unless where hypertrophy was also present. Hypertrophy and inflammation, according to the same authority, are only different stages or degrees of the same process; accordingly, a large proportion of cases of disease of the heart are hurried off by the supervention of pericarditis or endocarditis in their advanced period.

Anatomical characters. In hypertrophy of the heart, the muscular tissue is commonly of a deeper red, and more richly supplied with blood than natural, its coronary arteries are enlarged, and its density and firmness increased. In a very advanced stage, a state of induration in some cases, and of ramollissement in others, are occasionally observed. It occurs very commonly as one of the sequelæ to acute rheumatism, and frequently in connection with evident traces of inflammation of the interior or exterior lining membranes. Such are the appearances which have inclined Andral, Bouillaud, Elliotson, and other recent writers, to a belief in the frequent inflammatory origin of the affection. That its source may be occasionally of this nature, we are not prepared to deny; but believe that in the great majority of cases the increased bulk and firmness in the organ are the result merely of greater activity in the nutritive process, in consequence of a more abundant determination of blood from the greater demands made on its exertions. Whatever unduly and habitually excites the heart, or renders the performance of its ordinary task more difficult, whether the hinderance be seated in the heart itself, or extrinsic to it, must necessarily have this tendency, provided the vitality of the organ be unimpeached by any general or local debility.

Of all the forms of hypertrophy, that *with dilatation*, corresponding with the *active aneurism* of the heart of Corvisart, is the most frequent; next to it is that *with contraction* or diminution of the cavities; whilst that in which they remain *unaltered* in size appears to be the rarest of all. When the cavities are enlarged, there must obviously be an increase of substance in the parietes, provided they still retain even their natural thickness. It is not very usual to find but a single compartment affected: this, however, is sometimes the case. The left ventricle, from its greater energy and power of reaction, the greater task which it has to fulfil in driving the blood through the circuit of the general circulation, and the more frequent impediments which it has to overcome, is the cavity in which this change is most apt to occur, and in which it most commonly runs to the greatest excess.

In the right ventricle, hypertrophy is much rarer: when it exists in a well-marked manner, the ventricle no longer collapses, as in the natural state, on being emptied.

Hypertrophy of the left ventricle often co-exists with the same condition of the right, and sometimes with its simple dilatation.

The size of the cavity of the ventricles is subject to a considerable range in hypertrophy; being sometimes so distended as to be capable of containing the fist, or, if in the other extreme, so contracted as scarcely to hold the shell of an almond. When dilatation takes place, it may be either in a longitudinal direction, giving to the heart an elongated form, or, as is much more common, transversely, rendering it strikingly globular.

The thickness of the parietes of the left ventricle is sometimes carried to considerably above an inch; that of the right to four or five lines, and, in some very rare instances, even to more than double or treble that thickness, as sometimes in cases of open foramen ovale.

The instances in which the heart attains to the greatest magnitude, are those where *dilatation and hypertrophy* are combined; and here it is occasionally twice, or even thrice, its natural size. It is when both ventricles are thus at once so affected, that the organ becomes most remarkably rounded, the apex being in a manner obliterated, and that it assumes a transverse position in the chest, occupying a very considerable portion of the thoracic cavity, occasionally

descending as low as the eighth rib, displacing the lungs, especially that of the left side, and thrusting it up as high as the third rib. Where adhesions have taken place between the heart and the pericardium, and between the latter and the parietes of the chest, the organ as it enlarges is prevented from descending, as it otherwise would do; and it is here, as has been remarked by Dr. Hope, that the cartilages of the ribs are most apt to become prominent.

When the left ventricle is much enlarged, whilst the right retains its natural dimensions, the latter has the appearance of a mere appendage let into the side of the former; when, on the other hand, the right ventricle is solely or chiefly hypertrophied, it descends unusually low, and may form the entire apex of the organ.

In simple and dilated hypertrophy, the thickness of the walls ordinarily increases gradually from the apex to beyond the middle of the ventricle, diminishing thence somewhat abruptly towards the great arterial orifices,—being thus, as it were, a mere exaggeration of the natural state; whilst in the concentric variety, on the contrary, the deposition seems to take place more equably over the interior, inclusive of the apex, to which it gives a very blunt form.

In some instances, the augmented deposition in the walls takes place in a very irregular or partial manner, some parts appearing thicker and others thinner than natural. The columnæ carneæ generally participate in the affection of the parietes; yet, where the cavity is much enlarged, they sometimes may appear, from their elongation, rather attenuated. The septum is, for the most part, much less affected than the exterior walls; yet in some rare cases it is alone thickened, as may likewise be the case with the columnæ carneæ. The cavity of the right ventricle has been found almost entirely filled up from the latter cause, the enlarged fleshy columns becoming mutually adherent at their adjacent points, and thus forming a complicated muscular network, which must have considerably impeded the motion of the blood.

The parietes of the *auricles*, or rather their musculi pectinati, and especially those of the right, are also occasionally the seat of thickening; but this is scarcely ever observed without a coincident dilatation of their cavity; and very seldom, indeed, without the co-existence of enlargement or hypertrophy of the ventricles.

The weight of the heart, when considerably enlarged, may be raised to twice or thrice what it is in the natural condition, as we have already mentioned with more detail in the introduction. (See p. 255.)

The *symptoms* of hypertrophy of the heart are either local or general; and it is only from the combined study of both, that we can determine with any certainty the existence of the affection in the earlier and, practically speaking, the most important period. Exclusive attention to the physical signs has been emphatically deprecated by Laennec and all the most judicious of his followers, as tending only to bring them into disrepute, and often to lead the physician into lamentable error.

Of the *local symptoms*, or *physical signs*, the one which earliest attracts our attention is the great increase in the force of the heart's pulsations, and of the extent over which they may be felt or seen. On applying the stethoscope, the ear is forcibly thrown up by a gradually heaving motion, and over an unusually large space, extending occasionally, if the enlargement of the heart be extreme, from the third to the seventh or eighth rib; the whole mass of the enlarged organ seeming to come into contact with the thoracic parietes at each pulsation (the apex beating generally more to the left side, as well as at a lower level than natural), and then falling back, with a subsequent jog or shock at the end, called "the back stroke" or "diastolic impulse" by Dr. Hope, and ascribed to the refilling of the ventricles. The first sound of the heart is remarkably diminished in intensity, of a dull prolonged character, and audible only within a narrow sphere, provided the dilatation, if any exist, bears but a slight comparison to the degree of hypertrophy present; for the thickened muscular mass is but ill

adapted, as already explained, for the production or transmission of sonorous vibrations. Where, however, much dilatation co-exists with the hypertrophy, the sound is by no means thus impaired, but may be heard over a very extended surface in front, and occasionally even in the posterior portion of the chest; the impulse being strong, sharp, and hammer-like, somewhat as in nervous palpitations, instead of having the prolonged heaving motion characteristic of the purer form of hypertrophy. The *second sound* is little altered from its natural state in the simple variety when moderate in degree; it is generally diminished in the concentric, and augmented in the dilated, species. When the natural cardiac sounds are obscured in the præcordial region by a râle or a bellows-murmur, they may occasionally still be heard distinctly towards the top of the sternum or under the clavicles. The period of repose is much encroached on by the time consumed in the systole.

The pulsations of the heart, in the earlier part of the disorder, when not excited by any extraneous cause, are not ordinarily augmented in frequency; nor yet, if there be no contraction of the orifice, nor valvular disease, nor great dyspnœa or debility, are they irregular. The sense of palpitation, or rather a consciousness of the heart's action, is more constant in this than in other forms of heart-disease; but the palpitations rarely attain to such violence as is observed in cases of valvular lesion and pericardial adhesions, except as a temporary consequence of some unusual exertion or strong mental emotion. Where palpitations have thus been excited, a bellows-sound is occasionally heard during their continuance; but where this phenomenon is permanent, it may be considered an almost infallible index of the co-existence of organic obstruction from disease of some of the valves or orifices.

When the impulse and dullness of the first sound are more remarkable under the sternum, than under the cartilages of the ribs, Laennec thought the existence of hypertrophy of the right ventricle might be looked on as almost certain, — a reservation being made in favour of those cases of extreme enlargement of the left ventricle from the co-existence of hypertrophy and dilatation, in which this part of the heart may extend itself beneath the sternum.

In order to arrive at a valid conclusion from the stethoscopic signs, they must, as we have already intimated, be investigated at such times as the heart's action is neither unusually excited nor depressed. Low diet, previous loss of blood, or evacuations of any kind, or the oppressive dyspnœa attending certain stages of pulmonary affections, may so enfeeble the movements of even a greatly overgrown heart, as to render such an examination quite nugatory. Hence the propriety of auscultating repeatedly, and, under every variety of circumstances, is in all dubious cases obvious.

On percussion, a considerable extent of dullness is commonly recognised, commensurate with the augmented size of the organ, and consequently most considerable in those cases where the size of the cavities, as well as the substance of the organ, are greatly increased. Certain states of the lungs and cavity of the chest may, however, as already mentioned in the introductory remarks, interfere with the existence or value of this sign. (See p. 252.)

Prominence of the præcordial region, and an increased breadth of the corresponding intercostal spaces, are sometimes observable; and this appears to be especially the case when extensive pericardial adhesions exist, and in children, in whom the parietes are more yielding. An uneasy sensation, a feeling of weight, or a dull pain, is occasionally felt in the situation of the heart.

General symptoms. In simple hypertrophy of the left ventricle, and also in those cases where thickening predominates decidedly over co-existing dilatation, if no narrowing of the orifices nor valvular or aortic disease is present, the *pulse* is strong, full, and tensely prolonged under the finger in consequence of the protracted systole of the overgrown ventricle, but at the same time regular. With these characters of the arterial pulse, a thrill is occasionally associated; but, as it appears to Dr. Hope, only in those instances where anæmia has been superinduced, all cases of obstruction and regurgitant lesions being for the

present excluded from our consideration. In concentric or contracted hypertrophy, likewise, the pulse is tense and throbbing; but, in consequence of a smaller wave of blood being emitted at each systole of the heart, it is necessarily smaller than in the preceding instances.

Hypertrophy, as distinguished from dilatation and other lesions causing impediment to the circulation, is further characterised—at least, in its earlier stages—by greater activity of the capillaries, a more highly arterialised blood, a brighter eye, and a more brilliant complexion, provided the colour was naturally florid. Thus, in the incipient period, the functions of the body, as Bertin remarks, are not necessarily at all impaired; on the contrary, they appear rather to be executed with increased energy, and there is, in general, a fallacious show of high health and vigour. At a somewhat more advanced period, there are frequent flushings, with marked tendency to active hæmorrhages of the brain and mucous membranes. These latter, when they take place from the Schneiderian membrane, or from the hæmorrhoidal or other vessels of the intestines, to only a moderate extent, must be considered as exercising a salutary influence over the complaint. Hæmoptysis is likewise a frequent symptom, and perhaps more especially when the right ventricle is affected. The augmented volume of the heart may, by encroaching on the lung, in some degree interfere with its function; yet the respiration is, for the most part, much less early or severely compromised than in cases of simple or passive dilatation, or other lesions tending directly to impede the circulation; and at the same time the tendency to venous congestion and serous effusion throughout the body supervenes much more tardily. If, however, these cases be not cut off in their progress, as is often the case, by a sudden arrest of the heart's action, or by apoplexy, or inflammation of the lungs or some other organ (the inflammatory diathesis being strongly marked), engorgement of the capillaries both of the lungs and of the general circulation eventually takes place; and it becomes at length evident that such patients have no special or complete immunity from cough, dyspnœa, and other pulmonary symptoms, nor yet from dropsies of the cellular membrane and great cavities. These secondary affections are here, however, of a somewhat less inveterate character, and more susceptible of alleviation by judicious treatment, than where they originate in obstruction. The œdema connected with hypertrophy, Dr. Hope remarks, usually makes its first appearance in the face, in consequence of the naturally very copious supply of blood to the head, and its proximity to the heart, in virtue of which it receives the full force of its morbidly vehement contractions.

A slight tendency to difficulty of breathing on unusual exertion may sometimes be noticed, even from a very early period. This is especially felt at the commencement of any great muscular effort, diminishing in some degree as the body gets warm, the blood becoming determined to the surface, and the cutaneous exhalation augmented.*

Though hypertrophy of the heart may almost always be recognised by a careful consideration of all the physical and general signs, it is not possible, in every instance, to say which cavity is chiefly affected. Most of the signs hitherto detailed, apply more particularly to hypertrophy of the left ventricle. Where it is greatly augmented in bulk, its enlargement is, indeed, very usually complicated with a similar affection of the other cavities. If, however, as is

* This phenomenon of "the second breath," or "getting into wind," as it is called, is well known to all who practise athletic exercises, trainers of horses for the course, &c. The writer of this had himself practical experience of it in a remarkable degree, in ascending Ætna on foot at an early period of the year, when the sides of the mountain were still covered with frozen snow to a distance of upwards of twelve miles from the summit. The ascent of this slippery inclined plane, extremely fatiguing even to one at the time accustomed to considerable pedestrian exertions, gave rise, during the first two or three miles, to a very painful acceleration of the respiration and pulse; the heart throbbing with such violence as if it would burst through the side, or cause instant death; yet, under the forced continuance of the exertion (and any relaxation would have been perilous, on account of the intensity of the cold) this oppressive sensation gradually declined; and after many hours of almost incessant smart walking and running, the starting point at the foot of the mountain was regained much less with feeling of fatigue than had been experienced during the first mile of the ascent.

sometimes the case, the right ventricle is alone or chiefly affected, the increased dulness and impulse is most conspicuous under the lower part of the sternum, and the pulse has not necessarily the peculiar characters above detailed; whilst, on the other hand, there has commonly been thought to be a greater tendency to dyspnœa and hæmorrhages from the lungs (hæmoptysis, pulmonary apoplexy*, &c.). When the cavity is at the same time dilated, and its valves, from this or any other cause, insufficient, there will be regurgitation and jugular pulsation synchronous with the ventricular systole. From such an impulse as is occasionally transmitted to the vein by the carotid, this may be distinguished by being confined chiefly to the lower part of the neck, where the two vessels are far apart. Pressure on the upper part of the vessel, again, does not interfere with it. It disappears in some degree during inspiration, and is most conspicuous during expiration. The pulsation of the jugulars, as remarked by Dr. Hope, is sometimes obviously double; the first motion corresponding to the contraction of the auricle, the second to the ventricular systole. Where there is simply impediment to the onward current, without actual reflux, there will be merely a dilated condition of these vessels.†

As to the *auricles*, we are not yet in possession of any unequivocal signs of their increased strength or enlargement, distinct from those of similar states of their respective ventricles; but with these they so frequently coexist, as to render their separate diagnosis matter of curiosity, rather than of practical interest. Percussion may sometimes, however, lead to a very strong suspicion, at least, of their enlargement where it exists in a marked degree; and the presence of a venous pulsation anticipating the ventricular systole might serve, in the case of the right ventricle, to confirm such suspicion.

In respect to the *wasting away of the eye*, or its inflammatory destruction, adduced by Testa, on the faith of a single case, amongst the occasional consequences of disease of the heart, the latter is so common, and the former so extremely rare an affection, as greatly to discredit the supposed connection; and the same may be said of gangrene of the limbs, which has sometimes been supposed to be a symptom of enlargement of the heart, on the authority of an old case in Fabricius de Hilden and two comparatively recent ones by Giraud, a contemporary of Corvisart. Whenever gangrene of the extremities does coexist with disease of the heart, it has been rendered probable, by the examinations of M. Bouillaud and Dr. Carswell, that it is connected immediately, not with the cardiac affection, but with local obstruction by a coagulum in the artery leading to the part. Whether, however, this obstruction is the cause or the consequence of the gangrene, is not to us so evident; for where the capillaries, from any circumstance, lose their vitality, impediment to the circulation and coagulation of the blood in the trunk by which they are supplied, seems an inevitable result. Mortification of a limb occurring in connection with a diseased heart, may, in some cases, moreover, depend merely on the pressure on the vessels and on the inflammation induced by the excessive effusion of serum into the cellular tissue.

Complications and secondary affections. Several of the complications met with in the course of hypertrophy of the heart, as, for instance, inflammation of the inner and outer linings of the organ, obstruction of the orifices, disease of the valves, aneurism of the aorta, serous and hæmorrhagic effusions, &c. have been alluded to in the preceding paragraphs. There are, however, some others which, their connection being less universally acknowledged, merit a more particular consideration; we refer especially to *general visceral enlargement* and to *apoplexy*.

* Pulmonary apoplexy occurs more frequently, according to Dr. Hope's and Dr. Wilson's experience, in connection with great contraction of the *mitral valve*, with or even without hypertrophy and dilatation of the right ventricle, than under any other circumstances.

† A jugular pulsation synchronous with the ventricular systole, and, as is so often the case, unaccompanied by "soufflet," is not considered by Dr. Hope as satisfactory evidence of actual regurgitation through the tricuspid valve; as he believes that an impulse fully adequate to the effect may, when the heart is enlarged and acting impetuously, be transmitted by the mere recoil of the valve against the column of blood behind it, — and this especially when both the valve and orifice are increased in size, and the veins congested.

Hypertrophy being characterised during the greater part of its progress by increased activity of the circulation, that there should ensue enlargement of the body generally, and more especially of the internal viscera thus profusely supplied with blood, and that too generally of a rich and highly reparative quality, is not surprising. That an increase of bulk takes place in such cases, more especially in the spongy organs, as the liver and spleen, had, indeed, long been known, and is specially mentioned by Lieutaud, Corvisart, Portal, Kreysig, Testa, and others; but was by many viewed rather as the cause than the consequence of the disease of the heart; and even where the true nature of the relation was recognised, the enlargement was very commonly ascribed to mere vascular repletion, or to infiltration. Dr. Clendinning has, however, very recently demonstrated, as already noticed in our introductory remarks on diseases of the heart, that even after incising the viscera, and draining off their fluid, there still remains a notable augmentation of weight as well as of bulk, indicating clearly that they have been the seat of an unusually active process of nutrition; and this he has found to hold good, not only of the two organs just specified, but also of the stomach, intestines, pancreas, kidneys (which last are sometimes, moreover, the seat of the peculiar affection described by Dr. Bright), of the lungs, especially the bronchial ramifications, and even of the brain. And this increase of substance, it was further stated, is not limited, as we should perhaps have expected, to cases of active enlargement of the heart, but occurs in all varieties of heart-disease, whether of an active, or passive, or obstructive nature, where the organ is enlarged, and the vascular system generally is kept in a state of abnormal repletion; so that it would appear, as he remarks, that even a comparatively stagnant or venous blood is adequate to the production of the effect in question.

Hypertrophy of the heart, as is justly remarked by the same author, does not necessarily imply an increase of efficient power; but rather tends, on the contrary, to induce deficient functional aptitude, as becomes evident towards the winding up of the disease,—the symptoms of dilatation at last beginning to predominate over those of hypertrophy, and the pulse often becoming soft and compressible.

The influence of hypertrophy of the heart, in the aggravation of other diseases originating during its course, is very conspicuous. The prognosis in all pulmonic affections (phthisis, pneumonia, bronchitis, &c.), in cerebral diseases (apoplexy, delirium tremens, and mania), as also in abdominal inflammations and fever, is rendered much more unfavourable by its presence. To many of these diseases, it moreover disposes in a peculiar degree; and more especially to chronic bronchitis, emphysema of the lungs, and to the asthmatic paroxysms generally immediately dependent on one or other of these morbid conditions; and also to softening of the brain and cerebral hæmorrhage; to brain fevers, inveterate headachs exasperated by stooping, nervous irritability, frequent ophthalmia with sparks and flashes before the eyes, ringing in the ears, and other minor evidences of determination of blood in undue quantity to the head.

The dependence of *apoplexy* on disease of the heart, to which attention was many years since called by Legallois and Richerand, and more recently by Adams, Lallemand, Johnson, Bricheteau, and Hope; and of which, indeed, even Lancisi, Baglivi, and others of the older pathologists seem to have been quite aware; may now be considered as one of the best established medical facts. In a large number of cases of hypertrophy of the heart, examined after death by Dr. Clendinning, apoplexy coexisted in three sevenths of the whole. Dr. Hope believes that the majority of cases of cerebral hæmorrhage have this origin, and agrees with Bertin and Richerand in ascribing to it more influence than even to the so-called apoplectic constitution.* Dr. Kellie and M. Rochoux have, as we are aware, endeavoured to discredit the connection alluded to; but the

* This influence is participated in, Dr. Hope is persuaded, by various other affections of the heart, as dilatation, softening, disease of the valves, &c.; inasmuch as they tend to produce congestion of the brain.

number of positive facts in its favour is too great to allow us to doubt of its reality. The ill effects on the brain appear to be, in some degree, counteracted by the occasional existence of narrowing of the aortic orifice, as has been pointed out by Bricheteau; but less so than we might expect, unless where the contraction is very considerable; and then the lungs are still more affected, and the tendency to serous effusions is more prominent. The thickening of the left ventricle is much more apt, it is supposed, to determine a cerebral hæmorrhage in those cases where ossification of the arteries within the head exists; a morbid condition, on the importance of which the late Dr. Baillie strongly insisted, in respect to its bearing on apoplexy; but in regard to which Dr. Cheyne, in an able treatise on this disease, has, as we were surprised to find, expressed a different opinion.

Causes of each form of hypertrophy. Concentric hypertrophy, or that with contraction of the cavity, has been supposed occasionally to originate in inflammation of its internal lining membrane, by means of which an increased stimulus is imparted to the nutrient vessels of the adjacent muscular layers; simple hypertrophy, or that in which the dimensions of the cavity are unaltered, to a similar action transmitted from the external or pericardial covering to the more superficial muscular fibres; whilst in those cases where there is great dilatation, as well as increase of substance, an inflammatory and obstructive agency would seem very often to be simultaneously concerned.

The very frequent coexistence of hypertrophy with endocarditis or pericarditis, to which we have so repeatedly alluded, and the analogy of the augmented growth taking place in the walls of other hollow muscles, as the bladder, stomach, or intestines, from a long continued inflammatory condition of their lining membrane, seem to favour this view. Indeed, the analogy might be pursued still farther, by observing that, in these cases, likewise, an obstruction to the free course of the contained matters often exists, and forms an additional link in the chain of causes and effects; giving rise, in some cases, to dilatation, and in others to contraction, of the viscus. It is, however, at the same time, almost certain that the increased muscular growth is not unfrequently a primary affection, occurring from excessive exertion of the organ, from the congenital preponderance of its power in relation to the rest of the system, or from some disproportion amongst its parts. Rheumatism, though it so generally makes its first attacks on its lining membranes, yet occasionally seems to act primarily, and almost exclusively, in the production of hypertrophy of the muscular tissue.

All violent exercises, if disproportioned to the strength, and especially during the period of growth—frequent and strong mental emotions—plethora—venereal excesses, or other causes giving rise to habitual palpitations—obstructions in the lungs or great vessels, and more especially aneurism of the aorta, and whatever makes unusual demands on the exertions of the heart,—necessarily tend, in the manner and under the circumstances specified in the commencement of this article, to produce increased nutrition of the organ, and along with this, most commonly, enlargement of its cavities. We may add here, that as the tendency of obstruction in a heart capable of struggling effectually therewith, is to produce hypertrophy, so the *constant over-distension* of the cavities, connected with permanent patescence of an orifice and reflux, and other causes, has appeared rather to lead to the predominance of dilatation.*

A preternatural communication between the right and left sides of the heart is often accompanied by hypertrophy of the right ventricle, and this has been ascribed to the admission of the arterial blood into it; though it is more probably, for the most part, an original condition bearing a direct relation to its abnormal participation in the general circulation, and the unusual demand on its exertions.

Hypertrophy of the heart, whatever may be its origin, must obviously, from the constant over-action of the organ, put it in a state favourable to the development of inflammation in its lining surfaces, and more especially of that in contact with the blood, and which covers the valves and orifices; and thus Peri-

* Hope, p. 260.

carditis and Endocarditis, though so often the cause, may frequently also be the effect, of enlargement of the organ.

Duration and prognosis. The shortest period within which this disease can develop itself, is uncertain. Though ordinarily an affection of many years' duration, yet it has, in some very rare cases, been known to present itself almost in an acute form, having assumed a well marked character apparently within a very few months, or even weeks. But this is, indeed, very unusual. When it is moderate in degree, and uncombined with serious mechanical obstruction to the course of the blood, or other severe complications, it may run a course of many years, provided the manner of life be temperate, and that every thing which might unduly excite the heart's action be carefully avoided. From a slight degree of the disease, and under the above conditions, even little inconvenience, beyond a slight shortness of breath, or occasional inconsiderable palpitation, may for years be experienced; nor is it even incompatible with the attainment of a very advanced age. In children, a preponderance of the size and action of the heart is indicated by strength of impulse; and loudness of its sound seems to be a very frequent, or even the natural condition, and continues in some degree up to the period of puberty, when the general development of the body establishes the due balance between the organ and the parts which it supplies.

As there is often much strength of body and particularly good powers of digestion in the incipient stages of this affection, the temptations to excess in exercise and diet are unfortunately strong, and too often lead not only to the rapid exacerbation of the disease of the heart, but also to the earlier supervention of apoplectic symptoms.

The formidable nature of the local disease, and the inefficiency of treatment, generally augment in proportion as dilatation tends to prevail over hypertrophy; and finally, the *prognosis* is still further and in a fearful degree aggravated by the existence of the various complications already so often spoken of, — viz. valvular disease, pericardial and pulmonary inflammation, aneurism of the great vessels, &c.

Treatment. From what has been said of the nature of this affection, and of the circumstances by which it is exasperated, it is obvious that the chief indications of treatment consist in repose of mind and body, or rather in the restraint of their exercise within very moderate limits, together with extreme temperance in food and drinks, pushed in aggravated cases, provided the period of life gives any ground for expecting to effect a radical cure, even to the length of abstinence, and aided by a systematic and persevering employment of sanguineous depletion and other evacuant remedies. It is in this form of heart-disease alone, — viz. where hypertrophy is either simple or decidedly predominant, that the intensely lowering method of Albertini and Valsalva could be applied with any rational hopes of permanent benefit; nor is it often that even here it would be justifiable. Where dilatation and debility of the organ form the leading features of the disorder, the mistaken employment of such a proceeding could only tend to exasperate the morbid condition, and accelerate the fatal termination. Hence the vital importance of a correct diagnosis is evident. Few practitioners of the present day would venture to propose, and still fewer patients would be found willing to submit to, the treatment advocated by the celebrated Italian physicians just named, in its extreme or most rigorous form, consisting of constant confinement to bed, reiterated venæsection, and a diet so low as barely to prolong existence. Laennec, however, has given his voice very warmly in favour of a modified employment of it, especially if early had recourse to. He commenced by taking away blood to a quantity just short of inducing fainting; and at brief intervals, as twice or thrice a week, for example, repeating the operation till the palpitation and the vehement impulse of the heart had been got under; and at the same time reducing the quantity of food to half that usually consumed, or even much lower, until the patient's strength was brought so low as to leave him only able to crawl about for a few minutes at a time:

and this plan must be persevered in steadily for at least eight weeks after all the symptoms of the disease have entirely vanished; and even then be only gradually relinquished, and instantly recurred to as often as these threaten to reappear; so that its whole duration may occupy many months, or even a year or years. Nor does he think it inapplicable even to the more advanced stage of the disease, where dropsical symptoms and general cachexy have supervened; and he believes that it gives an additional chance to the efficacy of the necessary diuretic or hydragogue remedies. Dr. Mackintosh, who countenances the same kind of treatment, and speaks of confining the patient to a couple of biscuits in the day, recommends, where there is difficulty in restraining his appetite, the exhibition of small nauseating doses of tartar-emetic variously disguised. Dr. Hope and Dr. Forbes are less sanguine as to the efficacy of this heroic mode of treatment, having observed that these large and frequently repeated abstractions of blood, though they may for a time slightly alleviate the patient's sufferings, generally lead eventually, and especially when employed in the advanced stage of the affection, only to augmented debility and increased frequency of the paroxysms of palpitation and dyspnœa, and to consequent shortening of life. The effect of large venesections in producing prejudicial reaction in the first instance, and attenuation of the blood subsequently, is well known. Dr. Hope, accordingly, in such cases, rarely takes away more than from six to eight ounces of blood, at intervals of two or three weeks, or even longer, so as just in some degree to keep down the heart's action, and to relieve dyspnœa; removing blood by cupping from the nape of the neck, if the head be much affected: the diet is to be moderate, — only the white kinds of animal food being permitted. and the use of liquids being restricted to small quantities, whilst stimulants of all kinds are of course strictly interdicted. Much benefit is often derived from the occasional application of a few leeches to the region of the heart: this mode of local bleeding may be had recourse to as an auxiliary to venesection; or it may be employed alone, when the powers of the patient render general bleeding not advisable. In regard to exercise, it should never be taken in such a manner as to hurry the circulation. Where bloodletting seems inexpedient, the daily use of saline aperients for a week or so at a time is a good substitute, or the exhibition of mild diuretics, as the supertartrate or acetate of potash, or the decoction of broom; and this, even before dropsical symptoms have appeared. Subsequently, a selection of the most powerful of the same class of remedies, or, if they have failed, and the dropsical symptoms are on the advance, hydragogue purgatives must be had recourse to.

From the known influence of the stomach, intestines, and liver, on the action of the heart, Dr. Forbes insists, with great justice, on the essential importance of close attention to the condition of these organs in this and other cardiac diseases.

Where there is much irritability of the nervous system, considerable benefit often results from the judicious employment of narcotics (*Williams, Lombard*, &c.), as the extracts of hyoscyamus, conium, or belladonna, or the salts of morphia in fractional doses, or, though more rarely, from one to two drops of hydrocyanic acid. In the use of opiates, however, we must be cautious, as they produce great general derangement of system in some individuals, — locking up the secretions, and disordering the functions of the stomach and brain, and so eventually aggravating the deranged action of the heart. Camphor, assafœtida, and ether may occasionally be had recourse to with advantage, especially during the paroxysms of dyspnœa and palpitation.

About the efficacy of digitalis in quieting the action of the heart in these cases, there is considerable variety of opinion. Laennec had little or no confidence in it; whilst Bouillaud, on the other hand, styles it emphatically "the true opiate of the heart." The last-named writer prefers the endermic method of exhibiting it, — a blister being applied on the skin of the præcordial region, and the raw surface sprinkled daily with from fifteen to sixteen grains of this substance in powder. Dr. Hope recommends the tincture internally, in doses of from

twenty to thirty minims twice or thrice a day; Dr. Davis is also partial to its employment. The coexisting state of other functions seems to have a great influence in determining the effect of this remedy; when the stomach or bowels are in an irritable or sub-inflammatory state, it is generally inapplicable. Of the danger of its accumulating in the system, and producing alarming depression and slowness of the heart's action, as well as of deranging temporarily the cerebral functions, and thus giving rise to a remarkable form of delirium, every one who ventures on its employment should be well aware, and always on their guard, and ready instantly to intermit its use and counteract its ill effects.

The hydrosulphuret of ammonia, in doses of four or five drops gradually increased to twenty or thirty, and largely diluted with water, was recommended some years ago by Dr. Marsh and Mr. Newton as a means of lowering the action of the heart without inducing much debility; but on the subsequent employment of it on a larger scale, in hospital practice, it does not appear to have sustained its character. (*Dub. Journal of Med. Sc.*, May, 1832; also a paper in same, by Dr. Thwaites, for Nov. 1832, vol. ii. p. 185.; and another by Dr. Graves, in same volume, p. 23.) In excessive doses, or insufficiently diluted, it causes headach, nausea, and giddiness; and its use requires much circumspection.

The preparations of iodine, from their known power of promoting absorption, more especially of the solids, and controlling some of the chronic consequences of rheumatism, have been recommended in this affection; and very recently, the long continued and frequent employment of mercury in small doses has met with a strong advocate in Mr. Salter; and Dr. Colles, likewise, has dwelt with much and just emphasis on the beneficial influence of this remedy over some of the most distressing effects of morbus cordis.

When the symptoms have once been reduced by some of the various measures just spoken of, the establishment of permanent counter-irritation, by means of an issue or seton, either in the region of the heart, or, what sometimes answers better, at some distance from the affected organ, as in the arm, for example, is advisable. When the disease dates its commencement from the suppression of a chronic cutaneous complaint, or from repelled gout, and when we cannot recal these affections, recourse to counter-irritation in some of its forms is peculiarly indicated. Colchicum, moreover, is a useful auxiliary.

During the paroxysm of palpitation and difficulty of breathing, Morgagni was accustomed to employ, as a palliative, warm pediluvia, and at the same time to have the arms plunged into water as hot as could conveniently be borne,—measures which seem to owe any slight beneficial influence exerted by them, to their drawing away an additional quantity of the circulating fluid to the extremities, and so temporarily relieving the heart; and with the same view, dry cupping over the chest and back may be employed. But when there is much congestion of the lungs, severe dyspnœa, troublesome cough, or evidence of thoracic inflammation in some of its grades and varieties, the scarificators or leeches should be applied, or a moderate venesection speedily practised. In advanced cases, however, and when the constitution is greatly enfeebled, the recurrence to general bloodletting demands much caution and discrimination.

Even in its earlier, uncomplicated, and most curable condition, hypertrophy of the heart requires for its permanent removal that the treatment should be steadily pursued, and for a very considerable period, which may be stated on an average at about one or two years. A slight intermission of the symptoms soon after the treatment has been commenced, affords no warrant for its interruption, but rather an inducement to proceed in the same path.

In all cases the patient, if he would avoid the speedy recurrence or aggravation of the complaint, must make up his mind for a life of temperance and self-control, both moral and physical. All overloading of the stomach, whether

with solids or fluids, however simple their nature, is to be studiously avoided, and a rather low scale of diet habitually adhered to. The age and habit of body, and the previous mode of living, must, however, be taken into consideration; for an extreme system of abstinence will, in many cases, by deranging the digestive functions, and unduly augmenting the nervous sensibility, give rise to a state of body very unfavourable to the regular and moderate action of the heart. Though violent or prolonged exercises are obviously improper, the opposite condition of total indolence and inactivity is scarcely less to be shunned, except at very aggravated periods of the disease; the object to be kept in view, being, on the one hand, to avoid all undue excitement of the nervous, vascular, and muscular systems; and, on the other, to support an equable distribution of power throughout the several functions, a healthy action of the capillaries, and a free state of all the secretions and excretions, and so to guard against the dangers of plethora and of local accumulation.

DILATATION OF THE HEART.

Nature and mode of production.—Anatomical characters.—Physical signs.—General symptoms.—Diagnosis.—Treatment.

Of the influences under which dilatation of the heart takes place, we have already spoken in the commencement of the preceding section, and also in our "General Observations on Diseases of the Heart," p. 280. It was there seen that they are reducible to obstruction in the course of the circulation, and weakness of fibre in the heart, often occurring simultaneously, though the latter alone seems adequate to the effect. When the power of the heart is not proportioned to the mass of the blood to which it should give motion, nor to the extent of the circulation, there is necessarily a tendency to accumulation and distention. It is in those who are advanced in life, and of a tall, slight make, and relaxed habit of body, that it is most apt to originate. On dissection, the muscular tissue of the part is very generally found to be unnatural in consistence and colour, being flabbier and easier torn than usual, and commonly of either an unnaturally pale or dark hue. It was conjectured by Burns, that the attenuation of the parietes might eventually be carried so far as to cause them to give way at some point; and Dr. Hope has since actually met with such a case, the patient having expired suddenly at stool, a fissure of an inch in length being discovered in the left ventricle, which was softened, and of a violet colour around the aperture; and he alludes to a somewhat similar case, on the authority of Dr. Williams.

Of the local conditions said to predispose to dilatation, one of the most probable is weakness of one or more of the compartments of the heart of congenital origin; or a similar state induced under the influence of disease, as of inflammation of the organ, for example, and especially of its internal or external linings; for to the state of over-action in a muscle, induced in the first instance by the inflammation of a membrane in contact with it, one of atony is very apt, as Abercrombie has remarked, eventually to succeed.

Various general debilitating causes, as protracted fever, scurvy, and perhaps also scrofula (*Dr. Cheyne*), chlorosis, excessive losses of blood, or the relaxed state of the solids, brought on in some habits by the long-continued use of mercury,—or, in fine, impairment of the nutritive and stimulant qualities of the blood, however arising,—may be placed amongst the predisponents to this affection.

Chronic obstructions in the lungs, habitual paroxysms of dyspnœa or of nervous palpitation, sexual excesses, or any efforts which demand a frequent

and protracted suspension of the respiration, or which at the same time accelerate the afflux of blood to the heart, and diminish its powers of re-action — violent as well as depressing passions, constant compression or deformity of the thoracic parietes, and trades in the exercise of which the trunk is ordinarily kept much bent, and the circulation on the descending and abdominal aorta interfered with, — all obviously have a tendency to aid in the development of the disease; as must likewise, and in a still more powerful manner, aneurism or other obstruction of the aorta, obstacles seated in the orifice of the heart itself, and lesions admitting of regurgitation.

Obstruction in an orifice or imperfection in a valve commonly manifest their influence first in the cavity immediately behind such causes. Eventually, however, the whole organ may become dilated; and not very seldom a more distant cavity, apparently from being peculiarly weak and yielding, suffers earlier than that in closest proximity to the obstacle.

Above all other causes, the most influential, according to Laennec, is congenital debility or disproportion in the organ itself. Few individuals, he believed, will be found to have a perfectly proportioned heart, if we compare the cavities amongst themselves, or estimate the power and capacity of the organ in relation to the other parts, as the lungs, the vascular system, inclusive of the capillaries, &c. From such disproportion, if the habits be temperate and the mode of existence favourable, no marked inconvenience may result during the greater part of life; but, on the other hand, the sudden supervention of emaciation, or irregular habits, violent exertions, or, on the contrary, too sedentary a life, may destroy the balance of the circulation, and lead to the development of the morbid tendency.

Anatomical characters. Dilatation may exist either with an increased, a natural, or a diminished thickness of the walls of the heart. The two former conditions have already been alluded to, when speaking of hypertrophy of the organ. Where, however, the enlargement of the cavities predominates greatly over the increase of substance in the parietes, the symptoms of debility and obstruction preponderate, and require, even from practical considerations, that such cases should be arranged under the head of dilatation rather than that of hypertrophy. Dilatation with attenuation is, however, a much rarer affection than that with an opposite condition of the parietes. In dilatation of the simple or passive kind, the parietes of the left ventricle are sometimes rendered as thin as those of the right in its natural condition; whilst the latter may be so attenuated as not to exceed the auricles in thickness. The simultaneous dilatation of both these cavities is much more common than that of only one. The columnæ carneæ are necessarily elongated, and participate in the general wasting of the organ. The septum ordinarily suffers least. Dilatation does not always affect the whole extent of a cavity; thus it is occasionally almost confined to the upper portion of the ventricle, or near to where the great artery takes its rise; and in other instances it is more conspicuous in the lower part or the neighbourhood of the apex.

The auricles, from the less resisting nature of their parietes, are, according to Bouillaud, more prone to dilatation than the ventricles*; and the right ventricle, from the same cause, is more exposed to this change than the left. The right cavities have an additional source of dilatation in the frequent obstructions which occur to the pulmonary circulation.

Dilatation and hypertrophy of the auricles almost always present themselves combined.

In attempting to decide upon the existence of dilatation of the auricles, it is

* This opinion is not, however, universally adopted. Dr. Williams's experience leads him to think that the right ventricle and the left auricle are the most common seats of simple dilatation; whilst Dr. Hope believes with Laennec, that the auricles, from being protected by their valves from the direct influence of the numerous causes of pressure which operate on the ventricles, are far more exempt both from dilatation and hypertrophy, — at least, as long as the valves are perfect. But where disease of the auricular valves arises, causing impediment or regurgitation, it speedily leads to their dilatation.

to be remembered, that though these cavities, in their natural state, are of nearly the same capacity with the ventricles, yet the external magnitude of the former, in consequence of the thinness of their walls, should not be more than half that of the latter. Another circumstance to be kept in mind, if we would avoid error, is, that the auricles, and especially the right, are liable to a considerable degree of temporary distention from the accumulation of blood in them taking place just before death, especially when of a lingering kind. This must be carefully discriminated from the structural change constituting permanent dilatation. As in the latter case, a certain degree of hypertrophy ordinarily coexists, their parietes are more opaque, and, as remarked by Laennec, they do not shrink in the same manner on removing the contained blood, as when they are simply and recently distended.

Disease of the mitral valve often gives rise, not only to dilatation of the left auricle, but also, from its influence being reflected through the circuit of the pulmonary circulation, to that of the right ventricle and auricle.

Præternatural enlargement of the orifices of communication is very commonly associated with dilatation of the adjacent cavities; and where the growth or distention of the valves does not keep pace with such enlargement, or where the valves, from extreme attenuation, become perforated or lace-like, regurgitation is the result, and must necessarily tend to accelerate the progress of the disorder.

Physical signs. On applying the hand over the præcordial region, in the case of a greatly dilated and attenuated and feebly acting heart, a quick but very slight impulse is felt somewhat lower down, and more to the left side than natural. Even during the existence of palpitations, which are often peculiarly obstinate in these cases, the shock of the heart is still very feeble. If there be considerable difficulty in recognising it at all in the recumbent or erect posture, as is sometimes the case, by making the patient lean forward or lie on his face it becomes much more perceptible. The extent of dulness on percussion is manifestly augmented (especially in the directions just indicated in respect to the impulse), provided emphysema of the lung do not interfere. Recourse being had to auscultation, the first sound is found to be of a peculiarly loud, clear, and brief character, approximating much in quality to the second sound, and being heard over a greater extent of the chest than natural; whilst the interval of silence is relatively augmented, in consequence of the shortness of the first sound. When the action of the heart is distinctly heard in the dorsal region, and the first sound is quite as clear as the second, the dilatation, according to Laennec, must be very considerable. When it is most loud under the cartilages of the left lower true ribs, the left side is chiefly affected; when under the inferior portion of the sternum, the right is principally implicated. Of the circumstances which limit the value of these deductions, especially that which regards the extent over which the sound is audible, we have already spoken at large in the introductory remarks, p. 261. Dr. Hope, we may add, trusts much more to the quality of the sound, especially its shortness and clearness, than to its loudness; for he thinks that it is often louder in dilatation with hypertrophy, or even with a natural thickness of the parietes, than with attenuation; which last, when extreme, must tend greatly to weaken the energy of contraction; and this is in conformity with the observation of M. Bouillaud, though opposed to the more commonly received opinion originally promulgated by Laennec. The sound often loses its intensity for several days previous to death; and this is especially the case, when there is considerable softening of the muscular tissue, or an obstructed state of the lung.

General symptoms. The pulse is large, soft and compressible, and slow of reaching the distant arteries, but not essentially prone to irregularity or intermission when the dilatation is uncomplicated with softening of the heart, narrowing of the cardiac orifices, or valvular disease. In the latter stages of the affection, however, when excessive debility has supervened, as well as

during severe attacks of dyspnœa, the pulse often becomes both irregular and small. The lungs are early and much oppressed, their vessels being over-distended with blood, and the pulmonary tissue infiltrated,—circumstances which explain the distressing tendency to dyspnœa, hæmoptysis, and habitual cough, with abundant watery expectoration. The capillary circulation is languid, the extremities consequently inclined to be cold; there is ordinarily little physical activity, and often a constitutional tendency to depression of spirits.

The necessary result of the accumulation of blood within the heart and lungs in these cases, is impediment to the venous circulation all over the body. Hence the early supervention of serous effusion, first in the extremities, and subsequently in the thoracic and abdominal cavities; the purple tint of the face, if the capillary vessels there be naturally much developed, or otherwise a pallid or leaden hue; congestion of the cerebral vessels, evinced by dull pain of the head; frequent recurrence of frightful dreams, and sudden starting from sleep in alarm; great want of mental energy, and for some time before death a marked tendency to stupor or coma—symptoms which appear to be connected in some instances with serous effusion within the cranium, and in others with extreme vascular distension. The mucous membranes are universally congested, and passive hæmorrhages from them, consequently, are frequent in the form of epistaxis, melæna, or bleeding from the intestines, &c. The viscera generally are enlarged and gorged with blood, more especially the liver; and the obstructed state of the portal system necessarily helps to accelerate the supervention of ascites. The general symptoms of dilatation of the right ventricle are scarcely to be distinguished from those of impediment to the circulation from other causes, and may be stated generally to consist in extreme dyspnœa, with a very early appearance of venous congestion, hæmoptyses, pulmonary infiltration, and universal dropsy. According to Laennec, an habitually swollen state of the external jugular veins, without pulsation, and not ceasing on the compression of the vessel in the upper part of its course, is one of the most frequent indications of this affection, and next in value to those furnished by the stethoscope.

Of dilatation of the auricles, as already stated, no characteristic signs are yet known; but the existence of such a condition may be looked upon as almost certain, when considerable obstruction or regurgitation is recognised in the adjacent orifices, or great enlargement of the ventricles has been detected together with a remarkable increase of dulness on percussion about the base of the heart. Most of the general symptoms usually ascribed to dilatation, as, for instance, the overloaded state of the capillaries, serous effusions, and passive hæmorrhages, are by Bertin referred directly and solely to some mechanical obstacle to the circulation, the common cause, according to him, both of the symptoms in question and of such enlargement. But this is too narrow a view, according to Dr. Hope, who very justly remarks that debility of the heart is in itself a sufficient cause of accumulation of blood and consequent obstruction, and of the whole train of morbid effects just alluded to. Mechanical obstacles seated in a valve did not appear to Laennec, unless very considerable, necessarily to derange the circulation in any material degree, prior to the occurrence of enlargement of the heart. This latter state alone, on the contrary, and in the absence of all impediment at the orifices or in the great vessels, is quite adequate to produce great embarrassment, the distended and weakened muscular fibres being incompetent to deliver the organ duly of its contents, or to make way for the returning blood.

The *prognosis* in dilatation of the heart, when simple and moderate in degree, is much less formidable than where there is hypertrophy. It may often, by a tranquil mode of life, the prompt and appropriate treatment of any febrile or inflammatory disorders by which the patient may be casually attacked and which tend so injuriously to excite and derange the circulation, be prevented for many years from increasing, or causing any considerable inconvenience beyond the weakness of habit and tendency to dyspnœa on exertion which ac-

company it. When however dropsical effusions make their appearance, and in spite of regimen and medical treatment recur at short intervals, the fatal termination of the case, at no very distant date, is to be apprehended. The rapidity of its progress and the severity of the symptoms will however depend in a great degree on co-existing lesions, and more especially on disease, or inadequacy of the valves, obstruction of the orifices, and a chronic morbid condition of the bronchial membrane.

Treatment. When dilatation exists alone, or decidedly predominates over hypertrophy, and the action of the heart is consequently greatly weakened, a plan of treatment, in many respects the very opposite of that noticed in the last section, is obviously demanded. The object in the present case is, if possible, to improve the nutritive process in the heart, to augment the energy of its contractions, and so enable it more effectually to cope with the obstacles under the influence of which it is suffering. To fulfil these indications we are unfortunately in possession of no very direct means, and are obliged to trust to the influence of such agencies, therapeutical and dietetic, as tend gradually to improve the general health.

Where the tendency to dilatation can be traced to any obstruction of inflammatory or other origin in the heart or lungs, or in the course of the general circulation, the necessity of obviating its effects, or if possible entirely getting rid of it, is apparent. Inflammatory affections, especially of the organs contained within the chest, are to be promptly combated, and the absorption of effusions, whether of air or liquid, into the tissue of the lungs, or into the thoracic cavity, studiously promoted; the indulgence of all violent as well as depressing passions, and of every species of intemperance, restrained; unsuitable exertions of the respiratory organs and body generally, constrained postures and too sedentary habits avoided.

Where permanent obstruction in one or more of the orifices of the heart is in fault, or a congenital or deeply-rooted and long-established debility of the organ exists, it only remains for us in general to palliate existing symptoms, and to prevent, if possible, the supervention of new ones, especially of an inflammatory nature. Thus every precaution should be taken to avoid, or appropriate means exerted speedily to subdue catarrhal affections, as they tend so materially to aggravate the dyspnœa and to favour the development of the morbid condition of which we are treating. The body should be warmly clothed, and the cutaneous circulation strengthened by the use of the tepid shower-bath, diligent friction of the surface, and easy exercise. The diet should be nutritious without being stimulating, and the quantity taken at any one time ought to be very moderate, and liquids in particular sparingly indulged in, lest distension of the stomach and flatulence ensue, or relaxation of the muscular tissue generally, and that of the heart in particular, together with vascular repletion, be induced or augmented. Gentle but regular exercise, either walking, riding, or driving, according to previous habits and present strength, should be enjoined. The system should be braced by the occasional use of tonics, more especially some of the preparations of iron, and all dyspeptic ailments immediately attended to.

In the choice of a residence, the dryness and purity of the air and freedom from the necessity of perpetually ascending flights of stairs within doors, and hills without, should chiefly be considered. In the more advanced stage of the affection, when pulmonary congestion and copious expectoration set in, a warm and humid atmosphere, as is judiciously remarked by Dr. Hope, is often more suitable, inasmuch as it favours both the cutaneous and the bronchial secretion. Where the susceptibility to cold is very marked, and the period of life advanced, it may be advisable during the colder months in this variable climate to confine the patient to the house, his apartments being well ventilated, but kept at the same time of an equable and rather elevated temperature.

During the paroxyms of dyspnœa, the occasional exhibition of an antispasmodic draught, and the free admission of fresh air to the lungs, whilst the

surface of the body is protected by warm coverings, perspiration promoted, and the extremities plunged into warm water rendered somewhat stimulant by the addition of mustard, are amongst our chief resources. Opiates, though not altogether to be rejected, require caution in their use, as by checking the secretion or expectoration of mucus, they may often do more harm than good. Tea or coffee taken very hot, by their action on the nerves, and exhalants, sometimes afford considerable relief when the attacks assume the form of spasmodic asthma. Bloodletting to any extent is, generally speaking, inapplicable to this form of heart disease, and should scarcely ever be had recourse to, save with a view to cutting short the intercurrent inflammatory attacks, which occasionally complicate it; and even here the local abstraction of blood is generally preferable: and, along with the use of calomel and Dover's powder, or antimony and aperients, together with blisters and other counter-irritants, is commonly quite sufficient to this end.

In extreme cases of dyspnœa, however, when all other means have failed, the removal of a few ounces of blood in the remissions of the paroxysm may sometimes be warrantable; but it is always a perilous remedy, too often only increasing the general debility, and rapidly accelerating the progress of the case. It has even been known, when carried to any considerable length, to produce an almost immediately fatal result, the enfeebled organ being paralysed by the sudden reduction of its ordinary stimulus. For the treatment of *Dropsy* connected with disease of the heart, see CARDIAC DROPSY.

PARTIAL DILATATION, OR REAL ANEURISM, OF THE HEART.

Aneurism peculiar to the left side of the heart.— Aneurism of the left ventricle, its causes, symptoms, physical diagnosis, prognosis, and treatment.— Aneurism of the left auricle. — Aneurism of the valves.

DILATATION of the Heart is, in some rare instances, partial, being confined to one spot, which, being particularly yielding, gives rise to an aneurismal sac. Such aneurism may originate, as we have seen, in ulceration or in rupture of the interior of the heart, and the subsequent gradual distention of the muscular substance which forms the bottom of such ulcer or laceration. That it has not however always this source, but results occasionally from actual dilatation of all the coats of the organ, is deducible from the circumstance of its being sometimes possible to trace, in the earlier stage, the lining membrane of the heart in an unbroken form into the interior of these pouches. In some instances, again, the disease seems to begin by dilatation, and to end in rupture of the endocardium and inner muscular fibres: and here the case in its commencement will fall under the denomination of true aneurism; and at another part of its progress, of that of false consecutive aneurism of the heart.

So many as three or four of these pouches have, in at least one instance, been found in the sides of the ventricle. Hitherto it has been invariably in the walls of the *left* cavities, and most commonly of the left ventricle, that this disease has been met with. Aneurism in the heart, then, as in the vessels, would seem to be confined to that portion of the circulatory apparatus which transmits the arterial or red blood. The exemption of the right ventricle is ascribed by Mr. Thurnam, in a recent elaborate monograph on the affection which we are now considering, to the yielding or imperfect nature of the tricuspid valve already alluded to, which necessarily tends to diminish the stress on the walls of this cavity. M. Breschet and M. Cruveilhier, it is further remarked, were in error in

ascribing such exemption to the greater relative thickness of its apex as compared with that of the left ventricle; for the vicinity of the apex, as has now been fully ascertained from the examination of a larger number of cases, is by no means the only portion of the ventricle liable to partial dilatation. It is true it still appears to be somewhat more frequently its seat than other parts of the cavity, but it also occurs, and not a great deal seldomer, near the base of the heart, and in some rare instances, likewise, in the middle or thickest portion of the walls, and even in the septum and valves.

The aneurismal sac is found sometimes imbedded in the substance of the *ventricle*, and sometimes prominent on its exterior wall, and is met with of various sizes, from that of a nut up to that of an orange, and in extreme cases even equalling the heart itself. In old cases in which it has attained to a considerable magnitude, the mouth of the sac is generally narrower than the rest of it, and often opens into the ventricle by projecting lips, and has its interior filled in a great degree with laminated coagula. In a few instances steatomatous or cartilaginous degeneration has been noticed in its walls; and most commonly strong adhesions exist between its outer surface, even though as yet but very slightly prominent, and the bag of the pericardium, the result of a process of nature which has the effect of strengthening the parts and preventing early hæmorrhage. The heart is very rarely free from other concomitant disease. The co-existing morbid alterations are, as Mr. Thurnam remarks, generally of an inflammatory origin, such as opacity and roughness of the endocardium, ossification of the valves, &c. Either dilatation or hypertrophy of the heart, or at least of the left ventricle, existed in above a third of all the cases, fifty-eight in number, which have been collected and carefully analysed by him. The frequency of the affection in males, as compared with females, is as three to one, — a disproportion which, though considerable, is far inferior to that known to obtain in respect to aneurism of the arteries: the latter, moreover, has been ascertained to be chiefly confined to the period of life comprised between the thirtieth and fiftieth year; whilst the analogous affection of the heart does not manifest a decided preference for any particular age from puberty upwards.

Of its *causes* nothing very precise can be stated, save that, like as in regard to many other diseases of the heart, fatiguing exercises, intemperance, vehement passions and rheumatism, have appeared in some instances to predispose to it; and that its first symptoms in a few cases have coincided with the reception of a severe blow on the chest, a bad fall, or violent mental emotion. In the great majority of cases Mr. Thurnam, contrary to most other observers, believes it to be of the nature of true aneurism, commencing by a gradual dilatation of all the tissues in consequence of a local weakness in the wall of the heart, probably for the most part of an inflammatory origin. He supposes further that it may have its source in the gradual distension of some one of the sulci or pits which exist in the natural state in such number amongst the adherent and variously crossing columnæ carneæ, through the agency of a coagulum spontaneously forming within it and enlarging it.

A variety of this affection, involving the whole circumference of the ventricle in a part of its length, is noticed under the title of *Diffused True Aneurism*, analogous to the cylindrical or fusiform aneurism of the arteries. A remarkable case of this kind has been met with by Dr. Macreight, in which the apex and adjacent portion of the heart were distended into a bag capable of containing a small orange, the walls of which were of a cellulo-fibrous texture, and ossified in parts, whilst the base of the organ was in a state of hypertrophy: ossification of the aorta and its valves was likewise present.

Another species, originally observed by Dr. Hope, is spoken of under the name of "dissecting aneurism of the heart," in which the blood burrows under the internal lining membrane, and makes its way out again into the cavity at some distance.

Instances of "hernial aneurism" have likewise been met with in the heart, where the internal coat, itself intact, protrudes through a hole in the middle

or muscular tissue, the sac being then formed jointly by the endocardium and pericardium.

In aneurism of the septum opening quite through into the adjacent cavity, we have a parallel to varicose aneurism of the vessels. There being thus, continues Mr. Thurnam, for every species of arterial aneurism, an analogous variety discoverable amongst the partial dilatations of the heart (if we except "the external mixed aneurism," for the impossibility of the occurrence of which in this organ there exists an obvious anatomical cause,—the absence of an external cellular coat), it is obvious how erroneous are the views of those who imagine an affinity to exist between general dilatation, or that affecting the interior of one or more of the cavities of the heart, and the aneurismal enlargement of an artery. Such general enlargement, by which the heart adapts its dimensions to co-existing circumstances in the circulation, is more allied to the physiological process by which the arteries become dilated, when there is an additional demand made on them, as in the case of the arteries supplying the gravid uterus or a tumour, or the collateral branches, which re-establish the circulation where a main arterial trunk has been obstructed.

The *symptoms* of this affection are very obscure. Its commencement is for the most part insidious, and not marked by any distinct functional derangement. In the more advanced period, dyspnœa, præcordial pain, or rather a sense of weight and uneasiness, dropsy, palpitation, and tendency to syncope, and other symptoms indicative of a disease of the heart, are occasionally present; but from the very common co-existence of other lesions of this organ, it is impossible to say how much of all these functional derangements can be fairly laid to the charge of the affection in question.

The *physical diagnosis* is as yet no less dubious. Negative evidence, as Dr. Hope remarks, might occasionally at least excite a suspicion of the true nature of some of these lesions,—as, for example, the absence of the appropriate signs of valvular disease, and of any of the varieties of pulse characteristic of better-known forms of cardiac disease. Dr. Williams apprehends that there may sometimes exist a bellows murmur or whizzing sound accompanying the systole, if the opening of communication be somewhat contracted, as also either a diminished, increased, or tumultuous action of the heart: if of unusually great size, there might possibly be a pulsating tumour felt opposite to the cartilages of the ribs, with increased extent of dulness on percussion, and perhaps some displacement of the organ. It might be practicable to distinguish it from aneurism of the descending aorta by the absence of any unusual pulsation or grating sound along the left side of the dorsal vertebræ. As to aneurism of the commencement of the aorta, which as it enlarges presses upon and occasionally bursts into the heart, it seems improbable that we shall ever be able to discriminate it by any characteristic physical signs from the affection here spoken of.

Where the septum is perforated from the bursting of an aneurism seated in it, cyanosis might, by its sudden supervention, lead to a suspicion of the nature of the case.

The *prognosis* of this disease, supposing its existence to be recognised, is evidently of the gloomiest description. Its duration would seem to vary from a few days to several months or years. Death has occasionally taken place by syncope, but more generally by internal hæmorrhage into the pericardium. It has been known to end in apoplexy, and also sometimes, like other cardiac affections, by obstruction of the lungs, and the gradual supervention of asphyxia.

The *treatment* most applicable to this disease, if discoverable, would partake equally of that proper in aortic aneurism and of that of dilatation of the heart; the objects being to induce organisation of the coagula, and obliteration of the sac, without at the same time too much sinking the powers of the organ. Hence a moderate use of the antiphlogistic system, together with the scrupulous avoidance of all stimuli, moral or physical, which could produce injurious excitement.

A single case only of *sacculated aneurism of the auricle* has been seen by Mr. Thurnam amongst all the pathological museums examined by him; and in this the pouch, about the size of a nut, was filled with coagula, and communicated with the cavity by a narrow neck. The aneurismal affection of the auricle is almost always or the *diffused* kind, involving the entire sinus or the appendix; the dilated walls being generally thickened and opaque, rough, and occasionally ossified, and the cavity occupied by fibrinous concretions. Narrowing of the mitral orifice exists in almost every instance.

Aneurism of the valves of the heart. The mitral valves have sometimes been observed to form an elongated pouch-like projection into the left auricle, of which an example has been recorded by Morand, another by Laennec, and a third by Mr. South. The aortic valves were found simultaneously extensively ossified, so that the development of the disease was probably intimately connected with impediment to the escape of the blood from the ventricle, and consequently greater reaction against the yielding, and, in most instances, diseased structure, of the dilated valve. A similar appearance has been met with in the aortic valves themselves, and even in the tricuspid. Coagula have not been observed in the pouches so formed; and for their absence the incessant agitation to which these parts are exposed, sufficiently accounts. Such aneurismal tumours must materially obstruct the passage of the blood by their bulk, and where the sac becomes eventually perforated by ulceration or rupture, regurgitation will necessarily take place. Their stethoscopic signs, we apprehend, will be merely those of obstruction or regurgitation.

ATROPHY OF THE HEART.

The heart, like other muscles, is liable to a remarkable diminution in size, more especially in certain kinds of chronic disease, as the tubercular, cancerous, and gastro-enteritic cachexies, which are attended with much general exhaustion and emaciation. It may likewise be induced by excessive and long-continued depletions, the pressure of pericardial effusions, obstruction of the coronary arteries, and perhaps also by a long-continued state of mental depression. In regard to this last, however, there will often be room for doubting whether it should be ranked as a cause, or as an effect.

In extreme cases the heart of an adult has been found to be no larger than that of a child, or even of an infant, having lost a third or half or more of its natural magnitude. For more precise information as to the extent to which such wasting may be carried, we must refer to what has been said in the introductory remarks. (See pp. 255—257.)

The cavities of the heart in these cases are often remarkably diminished in size, and the walls, in thus contracting on themselves, occasionally appear, notwithstanding their real loss of substance, even thicker than natural (but they are then commonly wrinkled on their surface), or the opposite state may present itself, that of extreme attenuation of the parietes with dilatation. The muscular substance is, moreover, very generally altered also in colour and consistence from its natural state.

Of the difference of opinion existing amongst pathologists as to the occasional connection of this condition of the heart with phthisis, we have already spoken, p. 256. Laennec, who seems to have considered it as a distinct well-defined disease, remarks that it confers a certain degree of immunity from inflammatory affections, and is, on the other hand, often accompanied by hypochondriasis and a tendency to faint from very slight causes.

The general *symptoms* are those of depressed vital energy manifested throughout all the functions of the economy, — emaciation and proneness to dropsical effusion; whilst the physical signs consist in peculiar feebleness of the sounds

and impulse; the latter being unusually circumscribed as to the extent in which it can be felt, and occasionally even altogether imperceptible, save in the prone position of the trunk; whilst at the same time the natural dulness on percussion in the præcordial region is either not at all perceptible, or is limited within unusually narrow bounds. The pulse is not only weak, but uncommonly small and thread-like.

As to the *treatment* of wasting of the heart, most of what has been already laid down in respect to the management of dilatation of the organ is equally applicable here.

CHANGES IN THE CONSISTENCE AND COLOUR OF THE HEART, MORBID EFFUSIONS INTO ITS SUBSTANCE, AND NEW FORMATIONS.

Induration. — Softening. — Œdema. — Hemorrhagic effusion. — Purulent deposits. — Ossification of its vessels. — Surcharge of fat. — Tubercle, fungus hæmatodes, or encephaloid cancer. — Scirrhus. — Tumours. — Serous cysts. — Hydatids. — Cartilaginous and bony deposits.

Induration of the substance of the heart has already been alluded to in connection with hypertrophy and with carditis; and it was stated that its density was sometimes so remarkably increased, that when struck it resounded like a leather dice-box, or the coriaceous hull of the cocoa-nut; and yet occasionally, even in these extreme cases, its colour has not deviated strikingly from that which is natural to it. Nor was its contractile power in these instances considered by Laennec, as it was by Corvisart, to be impaired, but, on the contrary, he thought it was even augmented, — an opinion which later observations by no means confirm — nor yet did he coincide with Bertin and Bouillaud, in looking upon it as a preparatory step to ossification, such a transition never having been observed by him. The one affection, moreover, he remarks occupies very generally the whole heart, and has its chief seat apparently in the muscular fibre; whilst the other morbid process is commonly very partial, and manifests a decided preference for the serous, cellular, or fibrous portion of its structure.

Softening of the heart, with various alterations of its colour, has likewise been already treated of in the section on Carditis, inasmuch as it appears to be sometimes at least of inflammatory origin. The sounds of the heart in well marked cases are much impaired, and when this change exists in an extreme degree, the first sound may be almost or altogether inaudible, the impulse likewise being notably diminished, except during the presence of palpitations. The beat of the pulse is brief and feeble, and for the most part unequal and irregular, or intermittent. Softening of the heart appears to predispose in a remarkable degree to dilatation of its cavities, as well as greatly to aggravate the nature of this lesion: where the two alterations co-exist, the former tends in some degree to prevent the clearness and loudness of sound characteristic of the latter; and the disproportion between the extent of dulness on percussion, and the intensity of the natural sounds of the organ, may lead to a suspicion of the nature of the complication.

A softened condition of the heart is often met with on dissection in cases of hypertrophy with dilatation, where death has been preceded by long and frequent attacks of dyspnœa, and where the patient having survived for some weeks in a state of impending suffocation, a high degree of venous congestion has taken place in consequence of the obstructed state of the circulation.

The diagnosis between softening and disease of the mitral valve — affections in both of which the pulse is small and irregular — may be made, as Dr. Hope remarks, by the absence of the murmur characteristic of valvular disease. The two lesions often however, it must be remembered, co-exist — and also

that a very similar irregularity of the pulse may depend merely on temporary nervousness, violent dyspnœa, or excessive debility, as in the moribund state. When hypertrophy and softening co-exist, we may generally, according to the same authority, recognise the first by the impulse of the heart being either constantly, or with occasional beats, decidedly stronger than natural — and the latter alteration, by the first sound being not only diminished, as in simple hypertrophy, but having moreover a short flapping character approximating to that of the second sound, as if it were now almost entirely dependent on the sound of valvular extension.

The softened and somewhat glutinous state of the heart, observed in the advanced stage of putrid fevers, was supposed by Laennec to be but a part of the general affection of the muscular system in these cases, owing to a diminution of their solid, in proportion to their liquid constituents. Dr. Stokes, who has recently paid much attention to this subject, takes rather a different view of it, considering the softening of the heart to be a peculiar local secondary effect of typhus, and often to exist where the muscles of locomotion are little, if at all, altered from their natural colour and consistence (*Dub. Med. Journ.*, March, 1839). Where it exists in a marked degree, the first sound of the heart becomes quite inaudible and the impulse deficient. From the great feebleness or absence of the systolic sound, he has satisfied himself that a valuable practical indication may be deduced in respect to the propriety of resorting to stimulants, and one which he holds to be much more trustworthy than the state of the pulse, which is not always, by any means, in accurate relation with it. Accordingly, where there is absence or extreme diminution of the first sound in typhoid fevers, he administers wine boldly, no matter what other secondary affections of the gastro-intestinal mucous membrane, pulmonary organs or brain, may co-exist, and believes that where the stimulant plan is, under such circumstances, neglected, and the strength not adequately supported until this and other concomitant secondary affections, as well as the fever itself, have run their course, syncope is very apt to occur and prove fatal. Where, on the contrary, wine and other stimulants having been diligently exhibited during a day or two, the pulse begins to lose its frequency, and the first sound of the heart becomes again audible, the prognosis becomes decidedly favourable, and the propriety of the line of treatment adopted confirmed.

There remains still another species of softening of the heart to be adverted to, — viz. that where an unusual quantity of fat envelopes the organ, and is intermixed with its muscular fibres, its substance in such cases loses altogether its natural firmness. and becomes of a peculiarly light colour, and seems prone to rupture.

It is probable that many obscure cases of sudden and unexpected death have their origin in syncope connected with ramollissement of the heart. The treatment of softening of the heart when independent of inflammation, or where this, if its original cause, has been subdued, is similar to that of dilatation, a morbid condition with which, as we have seen, it very frequently co-exists.

An *œdematous* state of the cellular membrane enveloping the heart, and connecting its fibres, has been noticed by M. Bouillaud both in connection with a general dropsical condition of the system, and also with a varicose appearance of the cardiac veins, indicative of the difficulty with which they discharge themselves into the right auricle in consequence generally of some concomitant obstruction within the heart. A similar dropsical state of the organ may also originate in obliteration of some of these same vessels.

The heart is occasionally the subject of *hæmorrhagic effusion*, either in the form of patches or petechiæ, on one or both of its surfaces, as has sometimes been observed both in land and seascurvy and in putrid fevers; or blood may be poured out in larger quantities, and either infiltrated into the very substance of the organ, or collected into a factitious cavity formed by the separation and laceration of its fibres, constituting the disease spoken of by some authors under the title of *apoplexy of the heart*. Cruveilhier, who has seen many instances

of it, believes it to be much more often than inflammation and ulceration the cause of rupture of the heart. Hitherto it has only been observed in the left ventricle, and generally in connection with hypertrophy.

The muscular fibres are found quite broken down and displaced, and a coagulum occupies the cavity so formed, and with it, at a later period, purulent matter appears to be mixed. Perforation towards the inner or outer surface of the organ seems to be a frequent result, as is likewise the false consecutive aneurism described by Breschet.

Purulent deposits within the parietes of the heart have already been alluded to in our account of carditis. When of inflammatory origin, the muscular substance surrounding them is generally in a softened condition. They have their source probably, in some instances, in the translation of pus in the blood from some distant organ in a state of suppuration.

The *vessels* which supply the heart are not exempt from disease. In addition to the varicose state of its veins just alluded to, *ossification* of the nutrient arteries is by no means very unfrequent in the aged: it is not, however, necessarily productive of the formidable consequences ascribed to it by Parry and some other authors, who have endeavoured to connect it inseparably, as already mentioned, with the group of intensely distressing symptoms described under the head of Angina Pectoris. Enlargement of the arterial and venous coronaries is, as Bizot has pointed out, the ordinary consequence of advancing years; and this is only in conformity with what we should expect from knowing that the heart, which is dependent on them for support, gradually increases in size and weight, as old age approaches. The derangement of the nerves which supply the organ has already been spoken of.

The heart is often found *overloaded with fat*, especially about its base, and along the course of the coronaries, in the furrow of separation between the adjacent cavities, and likewise occasionally on its flat surface. In such cases, there is often an excess of the same substance in the neighbouring mediastinum, especially in front of the pericardium. The muscular structure of the heart is ordinarily much reduced in thickness and firmness, where in contact with the accumulated fatty deposit, either in consequence of its pressure, or from the new appropriation of the nutritive fluid.

The heart in one or more of its cavities is in these cases frequently at the same time greatly enlarged. Though the adipose matter may occasionally penetrate for some way between the muscular fibres, yet the two structures do not here run insensibly into each other, but are, on the contrary, perfectly distinct, so as to be capable of being separated cleanly by the dissecting knife. Corvisart, Laennec, and Hope, all agree in considering this as a mere augmentation of a natural deposit, and unattended, as far as their experience reaches, with any definite morbid symptoms: still if in very great excess, it could scarcely fail, we apprehend, in some degree, to enfeeble or embarrass the heart's action. M. Chomel believes that it may, in such extreme cases, give rise to dyspnœa, palpitations, and a sense of sinking, together with feebleness of pulse and dropsical tendency; and others, as we have already seen, ascribe to it, though on less plausible grounds, the production of all the symptoms of angina pectoris. Dr. Hope considers its signs to consist in "diminution of the sounds, especially the first; irregular pulse without valvular disease; and oppression or even pain in the præcordial region; with general signs of a retarded circulation, producing cerebral, hepatic, and other congestions."

It is much more common in females than in men, and is met with frequently where there is no tendency to obesity in other parts of the body. The habitual use of fermented liquors to excess seems in some constitutions to favour the morbid deposition of fat in this as well as in other situations.

But besides the condition above described, the heart is liable, like the Solæi and some other muscles, to a species of *true fatty degeneration*, in which a portion of the muscular tissue of the organ becomes actually transmuted into adipose matter. This change seems generally to commence towards the apex of the organ, and

thence spreads upwards; and has appeared in some instances to be ushered in by inflammatory symptoms. Unlike the former species of fatty deposit, the transition here from the one to the other tissue is gradual and insensible. The affected parts are of a pale yellowish hue, softened, and greasy to the touch. The external muscular layers suffer first; and from these it spreads gradually inwards till a mere shell of muscular substance has been left, consisting, in extreme cases, such as that recorded by Mr. Adams, of little more than the reticulated interior of the ventricle; and even those fibres which are but little altered in appearance, will impart to paper a greasy stain, as Laennec has pointed out. The latter had never, within his own experience, known it to determine a rupture of the heart, and confessed himself unable to ascribe to it any characteristic symptoms. It seems obviously, however, from the cases recorded by Mr. Adams and Dr. Cheyne to predispose to serous effusions and to apoplexy, as the impediment to the circulation, necessarily connected with such a weakened state of the heart, would lead us to expect.

In two remarkable examples of greasy degeneration of the heart described by Mr. Smith of Dublin, globules of a limpid oily matter were found floating on the blood in such quantity that half an ounce of pure oil was with ease collected,—its presence affording, as Mr. Smith remarks, an additional evidence of imperfect assimilation. In one of these cases, too, rupture of the left ventricle had taken place. In similar cases the texture of the heart, which breaks down readily between the fingers, has been compared to liver by M. Bizot.

If this affection were recognisable during life, the appropriate *treatment* would consist in such measures, dietetic and medicinal, as are calculated to give additional activity to the processes of digestion and assimilation, to render the circulation less languid, and to cause the absorption of redundant adipose deposits;—such as suitable exercise in a bracing atmosphere, temperance in diet, due regulation of the functions of the stomach and intestines, together with the exhibition of such remedies as are known to increase the tone of the nervous, muscular, and vascular systems. The preparations of iodine, moreover, on account of their marked influence ever the absorbents, especially those of the cellular tissue, would seem here to be deserving of trial.

New formations. The heart, as compared with most other organs, appears to enjoy a remarkable degree of exemption from the formation of adventitious growths, if the products of ossification only be excluded, together with the warty and cauliflower excrescences on the valves, the nature of which has been already discussed in connection with the inflammation of the internal lining membrane.

The presence of *tubercle* in the muscular structure of the heart is rare, no instance of it being given either in Louis or Lombard's tables exemplifying the comparative frequency of the occurrence of tubercular matter in the different parts of the body, and comprising together above five hundred examples of the presence of this morbid product. Laennec, however, had met with it three or four times in this situation. M. Sauzier speaks of having detected it in the substance of the auricles of a strumous subject, and Dr. Hope once, in that of the right ventricle of a child. Andral states that it is never found in the heart without existing simultaneously in several other organs; but neither he nor Bouillaud appear themselves to have seen it so situated.

Fungus hæmatodes, the *encephaloid cancer* of the French, is likewise very uncommon here, though it has been met with, both infiltrated and in the form of separate tumours, but almost exclusively in cases where it was extensively diffused through other organs at the same time.

An example of what appeared to be true *scirrhus* was met with by Recamier; and Rullier and Billard seem to have seen each another. A fourth instance in an advanced state of carcinomatous ulceration, occupying the whole posterior surface of the left ventricle, is quoted by Andral from the description by Carcassonne in the *Transactions of the Royal Society of Medicine* for

the year 1776; which had been characterised by pungent pain, palpitations, small intermitting pulse, syncope, and orthopnœa.

In a few instances on record, cancerous disease implicating the heart has appeared to have had its origin in the anterior mediastinum, or in the fibrous layer of the pericardium. In a case of very marked cancerous diathesis, in which even the bones were extensively affected, we have seen a minute tumour apparently of a scirrhous nature under the pericardium lining the heart.

Melicerous, steatomatous, and *various encysted tumours* have also, though rarely, been discovered within the parietes of the heart. *Serous cysts,* varying in size from a pea to a hen's egg, have likewise been observed by Dupuytren and others in the same situation, but more commonly between the walls and the external serous membrane; and Andral once met with one, about as large as a small nut, attached to the internal lining of the right ventricle.

Hydatids have also been found in the substance of this organ: Morgagni mentions an instance of this kind, which appears from his description to have been an example of the genus Cysticercus; and Andral has recorded a similar one. They are, as observed by the last-named author, by no means rare in the heart of measled pigs.

The *symptoms* of these foreign growths are commonly very obscure. By their number, bulk, or interference with the freedom of the valves or orifices, they are obviously capable of occasionally producing both physical and general signs; but we are not yet in possession of definite knowledge of any symptoms which can be considered truly characteristic.

The encephaloid cancer or medullary sarcoma has sometimes been attended by fits of excruciating pain of a lancinating character, and by that peculiar sallow or straw-coloured complexion indicative of malignant disease; in addition to habitual dyspnœa, frequent palpitations, and finally dropsical symptoms.

Cartilaginous and bony deposits. Of morbid depositions of a cartilaginous or bony nature taking place in the valves, the tendinous zones of the orifices, or internal lining membrane of the heart (and especially in the left side of the organ), and also in its pericardial covering, or in the false membranes interposed between its two serous surfaces after violent attacks of inflammation, we have already given an account in the sections devoted to endocarditis and to pericarditis. But the muscular tissue itself is liable to a similar species of degeneration or encroachment, though such an occurrence here is infinitely more rare. Corvisart has detailed a case of hypertrophy of the left ventricle, where the heart at its point, and for some way upwards, was converted throughout its whole surface into cartilage, the columnæ carneæ likewise participating in the affection, and the mitral valve being diseased. The disease had obviously commenced by an inflammatory attack within the chest, about eighteen months before its fatal termination. The pulse was small and irregular, and quite disproportioned to the apparent energy of the heart's contraction. A similar case has more recently been met with by Mr. Smith of Dublin, in an epileptic lunatic of forty-five years of age, who died in a convulsion. "The cavity of the left ventricle of the heart was slightly enlarged, and its parietes diminished in thickness. The muscular substance had completely lost its natural colour and consistence, particularly towards the apex of the ventricle; it was converted into a dense, white, firm cartilaginous structure, the division of which with scissors required the employment of considerable force: the alteration of structure had extended to some of the carneæ columnæ, and the auricles were hypertrophied." The cerebral vessels were found distended with dark blood, the retardation of the circulation in them being probably, as Mr. Smith observes, a consequence of the impaired contractile power of the heart. M. Renauldin's singular case, in which the left ventricle was converted, as it were, into a petrifaction, the columnæ resembling stalactites within its cavity, has been already alluded to. In Burn's celebrated case of ossification of the heart, the pericardial sac which adhered to the ventricles, and the entire ventricles themselves, with the ex-

ception of about a cubic inch at the apex and part of the columnæ carneæ, were "ossified and firm as the skull." The patient, a woman of sixty, had never been known to complain either of palpitation or pain in the heart. Andral has seen an ossific tumour isolated in the middle of the muscular substance of the left ventricle. It is probable that, in all such cases, the deposit of phosphate of lime takes place into the intermuscular cellular tissue, and that the true muscular fibre in its proximity becomes atrophied and supplanted rather than absolutely transformed.

A bony girdle of varying width, its average breadth being about one inch, was found by Mr. Smith, surrounding nearly the entire of the base of the heart, in a man of thirty-nine years of age who had laboured under all the ordinary symptoms of diseased heart. The external surface of the ossific deposit was quite rough; its inner portion penetrated into the muscular substance of the ventricles, coming almost in contact with their internal lining membrane. The auricles were remarkably hypertrophied, a great portion of the duty of the ventricles having apparently devolved on them. The opposed surfaces of the pericardium were universally adherent, and the bony matter appeared to have been originally deposited in the adventitious membranes of inflammatory origin; and such is probably the true explanation of most of the superficial ossifications of the heart related by authors. Yet withal, ossification within the pericardial sac is much more rarely observed than in the case of most of the other serous membranes.

RUPTURE OF THE HEART.

Causes.— Frequency in respect of the different cavities of the heart.— Seats of this lesion.— Symptoms and treatment.— Rupture of the valves of the heart.— Wounds of the heart, and their treatment.

Rupture of the Heart may be caused either by external violence, or by its own efforts; but, in the latter case, previous disease of the organ seems almost a necessary condition.

Amongst the external injuries capable of rupturing the heart may be enumerated falls from a considerable height, even though the person lights on his feet; heavy carriages passing over the chest; the kick of a horse, or other severe blow. By such violence the ventricles, generally the right, as being the most exposed, the auricles, the valves, and septum, and the great vessels at their origin, have been known to be torn across or burst, even in cases when the parietes of the chest have escaped without any fracture or other obvious injury.

Of the morbid conditions which predispose to rupture, ulceration of the inner membrane, as already mentioned under the head of Endocarditis, is one, and, according to Laennec, by much the most usual one. We are not, on the other hand, aware of any well authenticated instance where it had its origin in ulceration commencing on the pericardial surface of the heart, though such an occurrence is obviously possible. Abscesses or tumours within the cardiac parietes discharging their contents through either or both surfaces of the organ, ramollissement, partial or general, also the condition described at a former page, under the name of Apoplexy of the Heart, fatty degeneration, or the thinning and weakening of its muscular tissue from any other cause,— and, finally, partial aneurism of the organ itself, or the continued pressure of an aneurism of the aorta, or other thoracic tumour, may all of them conduce to the same formidable result; and most effectively in those cases where impediment in the orifices or hypertrophy co-exists.

The immediate determining cause of rupture may be either some external

injury, or the momentarily augmented action of the organ itself; such as takes place from strong mental emotion, or during violent muscular exertions, as in struggling, coughing, vomiting, or straining at stool, &c. It has likewise been known to occur during an apoplectic attack, as also in the convulsions of an epileptic fit; and the Hun Attila's is not the only instance on record where the heart has given way in the act of coition. When, however, the predisposing conditions have already greatly weakened its walls, even the ordinary motions of the organ may suffice to rupture it.

This lesion, when occurring *spontaneously*, has been observed, in a great majority of cases, in the left ventricle; the right ventricle comes next in point of frequency, then the right auricle, and lastly the left auricle. When, however, it results solely from great external violence, the proportionate frequency of its occurrence, to judge from M. Ollivier's investigations, is in favour of the right cavities as compared with the left, and of the auricles as compared with the ventricles, — a circumstance for which position and relative weakness of walls appear sufficiently to account.

It seems from Dr. Townsend's tables to be twice as frequent in men as in women, and very rarely to occur spontaneously before the sixtieth year. In some instances more than one rupture has been detected in a single cavity. In a remarkable case related by Andral there were found no less than five lacerations in the back part of the left ventricle, unaccompanied by any obvious softening around their margins. As to the point where this lesion most commonly occurs, there is great discrepancy of opinion. Thus, according to the distinguished pathologist just named, the middle of the ventricle, notwithstanding its great comparative thickness, is the most frequent seat of rupture; and Laennec too remarks that it is rare towards the apex, though one of the thinnest parts. Dr. Townsend, with some other writers who have attended much to the subject, stands opposed to these authorities, and asserts, on the apparently satisfactory grounds of numerical investigation, that the apex of the left ventricle, or rather a point half an inch above it, and at the same distance from the septum, is the most frequent situation of this lesion, having been observed in nineteen out of the twenty-five cases analysed by him; and hence he thought we might deduce that Laennec was in error, in considering ulceration, which manifests no peculiar preference for this point, to be the chief source of rupture. Dr. Townsend thinks it is, on the other hand, most commonly the consequence of a form of hypertrophy described by M. Rostan as not uncommon in advanced life, in which, whilst an increase of thickness takes place towards the basis of the heart, the apex becomes thinner than natural, and a general softening of the parietes often co-exists.

The above evidence, in favour of the greater frequency of rupture near the point of the heart, though apparently so strong, is yet not altogether conclusive; for M. Ollivier from the examination of nearly double the above number of recorded cases of its spontaneous occurrence, in thirty-four of which it occupied the left ventricle, has ascertained that the apex was its seat only in nine; thus affording a fresh proof, that, to give solidity to deductions arrived at through the numerical method, a very extended basis of observation is indispensable: nor do we feel certain that the question is even yet settled.

In some rare instances the external fibres of the heart have alone been found lacerated, the fissure not extending into any of its cavities. When however the rupture is of some size, and penetrates quite through the parietes of the organ, death is for the most part its almost instantaneous result, in consequence of the sudden effusion of blood into the pericardium, the derangement of the functions of the heart by the pressure so caused, and the arrest of the cerebral circulation thence ensuing. Where the aperture however has been very small, and its track through the walls oblique, a coagulum has, in some very rare instances, been formed within it, and, with the aid of the great mass of coagulated blood in the pericardium pressing against the mouth of the wound, delayed the fatal event for a few hours, or even days. Theoretically speaking, even cicatrisation is not

impossible; and Rostan adduces a case in which this appeared to him to have actually occurred.

The immediate *symptoms* of rupture of the heart are, faintness, absence of pulse, sudden syncope with cold extremities, and collapsed features—a state of things very different indeed from that occurring in apoplexy with which the ignorant so often in the first instance confound these cases. In the effusion of blood within the head, death rarely, if ever, ensues so instantaneously.

In some instances of rupture of the heart, the fatal stroke has been preceded for some time by pain in the præcordium, extending occasionally to the left shoulder, with or without other symptoms of heart disease; whilst in others no premonitory ailments have existed.

Of the treatment of so suddenly fatal an affection it is almost unnecessary to speak. In the very unusual cases, however, where life is not instantaneously cut short, the obvious indications would be to support the nervous system in the first place under the shock which has been inflicted, and subsequently to keep down the action of the heart by absolute repose of mind and body, all even the slightest exertion of the voluntary muscles being scrupulously avoided; by complete abstinence from solid food, and making use even of liquids only in the smallest quantities, and by the employment of every means likely to promote the formation of a clot within the ruptured orifice, and to prevent its dislodgement.

The heart is subject, moreover, to another species of *partial* rupture, implicating its valves, their tendons or muscular columnæ, the occurrence of which commonly gives rise to sudden and extreme sense of suffocation, with excruciating pain, violent disturbance of its action, and indescribably tumultuous sounds within the chest. On applying the hand to the præcordium in a case of this kind, a singularly confused tremulous pulsation has been felt over the whole cardiac region. Various species of bellows-murmur will be audible where, the attachments of a valve having been extensively destroyed, the lacerated fragments flap to and fro in the corresponding orifice, and give rise to regurgitation, and probably also to more or less obstruction of the sanguineous current. This formidable accident has in some instances appeared to result from violent efforts, as in coughing; but has most probably in such cases been preceded by ulceration of the yielding part. Dr. Townsend has met with it in no less than three patients who were carried off by phthisis, and Bouillaud in a fourth case of the same kind, when the fits of coughing had been peculiarly violent: others have noticed it in connection with hypertrophy and dilatation of the heart. When life has been prolonged for some time after its occurrence, all the usual symptoms of heart-disease have generally soon set in, and on dissection the ruptured tendons have occasionally exhibited granulations on the seat of the laceration.

Wounds of the heart, although in a great proportion of instances immediately fatal, have yet in some and not very rare cases been survived for some days or even longer. M. Ferrus tells of a madman who forced a short iron instrument between the fifth and sixth ribs into the heart, which it traversed obliquely from below upwards, passing through the left ventricle and septum, and who yet lived for twenty days afterwards. A soldier, who fell on his bayonet, so as to penetrate the left ventricle, not only survived for two days, but was able during part of the time to walk about almost as if no very serious injury had been inflicted; but at length went off suddenly in the effort of evacuating the bowels. There is a case on record, apparently well authenticated, of an individual who survived a gun-shot wound in the chest for six years, a ball being found upon dissection in the right ventricle; and similar instances have presented themselves in the animals of chace, the ball being occasionally discovered embedded and incysted in the walls of the heart. In Dupuytren's *Leçons Orales* several examples of wounds of the heart which did not prove fatal for a considerable time after their infliction, are to be met with. The heart has occasionally been penetrated by the end of a fractured rib when

the accident has occurred under the influence of great external compression, even when no laceration of the parietes had been caused; as, for example, in the case of a man who was jammed between the wheels of two carts, and who became immediately insensible, and speedily breathed his last.

According to M. Ollivier d'Angers, the chances of surviving for some time or even recovering completely, are considerably greater in the case of wounds of the auricles or right ventricle than in those of the left ventricle; so likewise when the wound is very narrow and oblique. The circumstance of the weapon having remained fast in the wound has been known, as in the celebrated case of Epaminondas, to retard for a brief space the fatal hæmorrhage. Some of the examples of wounds of the heart alluded to above show that we should not absolutely and invariably despair of their recovery as of a thing utterly impossible.

The *treatment*, where the sufferer survives for a few hours after the closure of the external wound (which, to promote the formation of a coagulum, should be instantly effected) consists in free venesection, the application of cold to the exterior of the chest, and in keeping the individual, moreover, in a very cool atmosphere, exhibiting digitalis largely, and enjoining absolute quietude and abstinence. When the sufferer appears in imminent danger of suffocation from the internal effusion of blood, it might sometimes perhaps be proper to reopen the external wound, or, if it be cicatrised, even to make a new aperture for the removal of the contained fluid, but obviously only in such cases where from the return of the heat and colour of the surface, there is reason to suppose the hæmorrhage has at length ceased. The subject of wounds of the heart, though strictly surgical, has been introduced here chiefly on account of the light which some acquaintance with it is calculated to throw on rupture of the organ, a condition with which it is so closely allied.

POLYPOUS CONCRETIONS OF THE HEART.

Origin and mode of formation. — Anatomical characters. — Symptoms. — Prognosis. — Prophylactic treatment.

During a considerable part of the last century, *polypi*, or firm and adherent coagula of blood within the cavities of the heart and great vessels, were looked upon commonly as a fertile source of cardiac symptoms, many of the results now ascertained to have their origin in organic affections being at that time erroneously ascribed to them. Morgagni, and a few other of the more enlightened pathologists of his day, stood in opposition to the popular opinion on the subject, and denied their influence altogether, believing them to be merely a *post mortem* appearance, or, at the most, that the coagulation did not take place till the vital energies were on the very point of extinction. Both of these opinions were, however, too exclusive. The more accurate investigations of later pathologists have proved satisfactorily, that such formations do occasionally originate during life, and that it is possible for them to be the source of very formidable symptoms; whilst, at the same time, they have rendered it evident, that in the vast majority of instances they occur either in the very last moments of existence, or after death. Hence the division of polypous concretions into *true* and *false*.

That the blood is capable of coagulating, and even becoming organised within its natural recipients in the living body, we have ocular proof, in what takes place in inflamed and obstructed arteries and veins; and analogy would lead us to expect a similar change in a portion of the contents of the heart under similar circumstances. Accordingly, it is in those cases, where the passage of the blood through the orifices of this organ are impeded, either by disease of the valves, aneurism of the aorta, or obstruction in the lungs, or

where the lining membrane in contact with this fluid is inflamed, that this formidable change is most prone to occur; and this result seems often to be facilitated by a co-existing inflammatory condition of the blood itself, in which the fibrinous portion is in excess, as well as by anything which enfeebles the organ and retards or temporarily arrests its action, as in the instance of protracted syncope. Hence the too free abstraction of blood, or the injudicious employment of digitalis, tartar-emetic, hydrocyanic acid, and other agents which greatly reduce the powers of life, are fraught with peculiar danger in the latter stages of heart-disease; in which the machinery of the circulation, already working imperfectly, is, by comparatively slight causes, readily brought to a final stop.

Polypi, when there is reason to suppose that they have been formed for some time previous to death, are peculiarly firm, tenacious and fibrous in their structure, and adhere so strongly by a filamentous union to the parietes and columnæ carneæ, with which they are interlaced, that they break across in attempting to detach them, and leave the surface of the organ rough with their fragments; whilst on scraping these away, the membrane underneath is often observed to be covered with bloody specks, indicative of incipient vascularity, induced apparently by the irritative contact of the newly-formed substance, and constituting a preparatory step to its organisation. In addition to these appearances, it has been pointed out by Laennec, that in place of being uniformly white or yellowish like recent concretions, or the buffy coat of the blood, they are in parts of a pale flesh colour, or have a slight violet tinge, or finally are speckled over with bloody points, the rudiments of vessels: if of a still older date, they are perfectly consolidated with the endocardium, and are obviously as completely organised as polypi of the mucous surfaces.

Polypous concretions are more frequent in the right side of the heart than in the left; probably both in consequence of the frequent obstruction to the blood in its passage through the lungs, and of the extension of inflammation from the veins to its lining membrane, and the subsequent influence of this on the contained blood; as well as also from the introduction of purulent matter from distant parts, which comes into earliest contact with this portion of the organ, and forms there a nucleus, around which the fibrinous matter is deposited. When, however, extensive and firm coagula do present themselves in the *left* cavities, they ought always to be examined with peculiar care, as from the ordinary recession of the blood from this part of the organ immediately after death, there is the greater probability, *à priori*, that any such adherent masses have been formed during life.

Within the auricles, the concreted fibrinous matter ordinarily presents itself in the form of a thick lining over their internal surface, diminishing the capacity of their cavity, and sometimes by prolongation into the corresponding ventricles, embarrassing the action of the auriculo-ventricular valves, and compressing and flattening the muscular columns. When there is reason to suppose them of long standing, they are sometimes of a friable texture, resembling, to use the words of Laennec, an old rich cheese, or the decomposed fibrine in an old arterial aneurism.

The globular vegetations of Laennec, already spoken of, adhere occasionally by a pedicle of obviously more recent formation than themselves, and here, probably, have originated in the organisation of a small coagulum of blood. They are of various sizes, from that of a pea to that of a pigeon's egg, are hollow, and contain within their cavity a sanguineous fluid, if recent, or a sanious or puriform one occasionally, if of longer standing. The wart-like vegetations of the valves, likewise, have been supposed by Laennec to have their source in minute polypous concretions, rather than in the effusion of coagulable lymph, as asserted by Kreysig and Bouillaud,—for their consistence and colour is very similar to these substances, and they display, moreover, frequently a violet tinge towards their centre, apparently the trace of the colouring matter of the blood. It would perhaps, however, be nearer the

truth to say, that they originate sometimes in the one way, and sometimes in the other, or that both, when the excrescences are considerable, may be concerned in their formation. The very fact of their more frequent occurrence on the left side, where coagulation is a much rarer, and inflammation a more frequent event than on the right, must prevent us ascribing them solely or even chiefly to the source advocated by Laennec. The blood, when once it is coagulated and organised within the heart, as in other situations, exercises the power of a living substance, and occasionally secretes within its new-formed tissue purulent, tubercular, or even osseous matter. The ossific concretion met with by Burns within the heart, which was about equal to a hen's egg in size, had probably originated in this manner.

Kreysig has attributed to the inflamed parietes of the heart and bloodvessels a power of determining the coagulation of their contents. That inflammation of the endocardium promotes in some degree the formation of polypous concretions is indeed highly probable, the effused lymph or pus forming a centre, around which the morbid solidification commences; but the existence of such a condition cannot be admitted as essential thereto. The low degree of inflammatory action requisite, in order that they shall become eventually solidly adherent to the interior of the organ, may as well be considered the result, as the cause, of their presence, and probably often ensues merely upon the pressure and irritation produced by them. It is not in the young and sanguineous most commonly, but rather in the aged and debilitated, that this morbid appearance is met with; and the stagnation of the blood, however induced, seems alone, in any case, quite sufficient to cause its separation into its elements.

The symptoms of polypous concretions of the heart are nearly all referrible to the impediment to the circulation which they cause; as, for instance, the extreme dyspnœa, violent palpitation, and tendency to faint, sudden venous congestion, coldness of the skin and sense of sickishness, extreme distress and restlessness, — all of which are particularly characterised by the *suddenness* of their supervention. They are in some cases intermittent, making their appearance at uncertain intervals, and ceasing as instantaneously as they commenced. In such instances it seems probable that a portion of the newly formed mass floats loose by at least one of its extremities, so as to permit of its being carried temporarily by the current of the circulation into the auriculo-ventricular opening, or into the orifice of one of the great vessels. When the effects are more permanent, this circumstance may with great probability be ascribed to the greater magnitude and fixity of the fibrinous substance, and its constant interference with the play of the valves and with the freedom of the orifices of the heart.

The existence of polypus, says Laennec, is almost certain, when the motions of a heart, which had previously been beating regularly, become all of a sudden irregular, obscure, and confused to such a degree that we can no longer analyse them. The group of symptoms specified by Bouillaud as diagnostic, if they come on all at once, is as follows: — tumultuous pulsations of the heart, with dullness or obscurity of its natural sounds, together with a blowing, hissing, or musical murmur, orthopnœa, or a degree of difficulty of respiration bordering on asphyxia, in consequence of the obstructed state of the pulmonary circulation, extreme anxiety, congestion of the venous capillaries, and even loss of consciousness, coma, stertor, and occasionally convulsions resulting from the gorged state of the cerebral vessels, together with a remarkably small pulse and cold extremities.

If in the course of an acute inflammation of the heart, very great difficulty of breathing and extreme disturbance of the circulation set in suddenly, the rapid formation of the concretions in question may be suspected, with a high degree of probability, as their source; so likewise when there is sudden and very violent aggravation of an habitual dyspnœa.

The *prognosis* in this affection is, generally speaking, of the worst possible kind. As, however, coagula within veins have been known to undergo ab-

sorption, it is just within the bounds of possibility, that those of the heart also when small may, in some very rare cases, be susceptible of spontaneous removal.

The best *prophylactic treatment*, according to Bouillaud, consists in the repeated abstraction of blood and free use of diluents in those cases of organic and inflammatory disease, in which their occurrence is most to be apprehended: but Dr. Hope very justly cautions us against the empirical or indiscriminate use of bloodletting in organic diseases of the heart, and especially in cases of dilatation and softening, or even in the advanced stage of valvular lesions when there is already great debility, as here it will not only fail to prevent the formation of polypi, but, like the imprudent employment of digitalis and nauseants under the same circumstances, will, by augmenting the languor of the circulation, directly favour their occurrence; whilst at the same time it tends unnecessarily to reduce the strength, accelerate the advance of dropsy, and the fatal termination of the complaint.

M. Legroux puts some faith in the exhibition of potass or soda, or their subcarbonates, from their power of diminishing the tendency of the blood to coagulate, — a property of the alkalies well known to Huxham, who deprecates their continued use, lest a dissolved state of this fluid should be induced. Dr. Copland thinks the sub-borate of soda the most influential agent for preventing the concretion of fibrine, and dissolving coagulable lymph. The efficacy of mercury in effecting the latter object is also well known; but unfortunately in the vast majority of cases there is little time for the trial of this or any other remedy.

HYDROPERICARDIUM.

Causes. — Symptoms. — Treatment.

Dropsy of the pericardium may, like that of the other serous sacs, be either of an active or passive nature. The active species, or that depending on increased energy of the exhalants, is scarcely ever observed save as a consequence, or one of the latest stages, of inflammation of the pericardium, in which, when the original turbid, albuminous, or sero-purulent effusion has been absorbed, a transparent watery secretion gradually takes its place, which is either colourless, or with a slight greenish or pale yellowish tinge. Its occurrence in an active form, as an idiopathic and insulated affection, is so extremely uncommon, that it is difficult to point to an unequivocal example of it even in the writings of authors who have had the largest experience in diseases of the heart.

The passive form, or that resulting from impediment to the circulation, in consequence of obstruction in the heart or lungs, or from debility of the heart's action, is, on the contrary, by no means unfrequent; and its existence may be anticipated in most cases when there is a general dropsical tendency throughout the system, as well as in the final stage of many typhoid and malignant diseases, in which the fluids are deeply contaminated, and the capillaries relaxed; as in cases of cancer, for example, the worst forms of puerperal fever, the exanthemata, when accompanied by symptoms of putrescency, &c.

As to the quantity of effusion requisite to constitute hydropericardium, authors are not agreed. After death, whatever may have been its source, there is usually found a small portion of a serous fluid, amounting generally to a few drachms, within the pericardial sac, poured out either during the mortal struggle or after its termination. An effusion in such minute quantity, and taking place under such circumstances, does not fall within the scope of the term hydropericardium; nor does Corvisart recognise any thing under six or seven ounces as being entitled to the appellation. Laennec has not ventured to fix on any pre-

cise quantity as a minimum, contenting himself with saying, "a few ounces or a quantity exceeding that commonly found after lingering deaths." Bouillaud thinks that any thing above a couple of ounces may be considered as an example of dropsy of the pericardium, even though the mode of death may have been tedious. In many cases, however, there is no room for doubt as to the amount of fluid being sufficiently great to constitute a morbid state, as so much as one, two, or three pints are sometimes found; and Corvisart mentions an instance where there was no less than eight pounds. The serous membrane in some of these cases has been observed to have an opaque whitish or macerated appearance.*

Amongst the *symptoms* occasionally present, are a sense of weight about the heart and inferior part of the chest, and oppression in the breathing depending probably on the pressure of the distended sac on the lungs, diaphragm, and neighbouring parts. The pulse is generally small, frequent, and irregular, the integuments of the præcordial region being occasionally œdematous, whilst orthopnœa and tendency to syncope frequently co-exist. But all these symptoms taken together are very far from being conclusive as to the existence of an unnatural effusion; nor even, though it should be present, do they necessarily depend on it, but much more frequently on co-existing organic lesion within the heart.

Senac declares he had seen a motion of fluctuation in the left side of the chest in cases of pericardial effusion; and Corvisart believed he had himself felt a similar motion in the same situation; but as nearly all subsequent observers have sought in vain to confirm these observations, it seems probable that the tremulous feeble impulse of the heart may have led to deception.

In cases of considerable effusion there is a striking prominence of the præcordial region with bulging of the corresponding intercostal spaces, together with a very extensive dulness, sometimes reaching even from nipple to nipple, and all along the sternum from near the second rib to the ensiform cartilage, in a pyramidal form with the base towards the diaphragm. The pulsations are frequently quite imperceptible, at least in the supine position, and when felt in the erect or prone posture often present themselves at successive moments, as Corvisart remarks, in different points of the præcordium, sometimes more to the right, sometimes more to the left than natural, giving the idea of the organ floating free, and altogether unrestrained by its enveloping sac; and they are usually, moreover, preceded, with an appreciable interval, by the commencement of the systolic sound. The sounds of the heart are feeble and distant, as heard immediately opposite the organ, but are much more audible at the top of the sternum opposite the arch of the aorta, and over the great vessels at the root of the neck; which latter circumstance aids us in distinguishing the case from one in which the heart is really acting very feebly.

Withal, the diagnosis of hydrops pericardii is extremely difficult, unless the effusion be considerable: if it were less than a pint, Laennec thought the recognition of its presence impossible; and not by any means certain though of double or even triple this amount: but from its rarity as an idiopathic or leading affection he considered the discovery of it of the less importance. The greater tact which many now possess in regard to the practice of percussion, has however recently, in a considerable degree, diminished the difficulty of ascertaining the presence of pericardial effusion. Thus where it is only of a moderate quantity, M. Piorry speaks confidently of being able to detect it by making the patient whilst lying down turn alternately on the right and left side, and finding, by practising percussion successively in these two postures, that there is an obvious dulness which changes its place correspondently from

* Under the title of *hernia pericardii*, a curious case has recently been described by Mr. Hart, in which, along with hypertrophy of the heart, and dropsical effusion into the pericardium, there existed a pyriform sac, likewise containing water, occupying the anterior mediastinum, and connected by an aperture at its narrower end with the pericardial sac, close to its reflection on the aorta. If not congenital, it was probably formed by gradual pressure of the effused fluid against a weak and yielding portion of the pericardium.

the right edge and upper part of the sternum to its left and upper part, and cartilages of the upper ribs.

Treatment. The active idiopathic form of hydropericardium, if recognised in its earlier stage, would of course require to be treated on the same principles as other active dropsies — by bloodletting, mercurials, purgatives, and counter-irritants, and subsequently by diaphoretics, digitalis, and other diuretics. And similar means in a modified form may afford useful aid in the passive or secondary variety; though here the proper management of the primary affection or organic cause forms, in cases which are not as yet altogether hopeless, the chief object.

As a forlorn hope the removal of the fluid by a surgical operation has been recommended by high authority, but the practice has as yet but little support from actual experience. The operation proposed by Senac was paracentesis of the pericardium, by the introduction of the trocar between the ribs. Corvisart thought that if an operation were justifiable at all, the best method of proceeding would be to lay open the parietes first, and then the pericardial sac cautiously with the knife; whilst Laennec expresses a preference for trepannation of the sternum just above the ensiform cartilage, as in this way we avoid laying open the pleuræ, and escape the error of Desault, who attempting to perform the operation previously described, and having made his incision between the sixth and seventh rib of the left side opposite to the apex of the heart, mistook a circumscribed pleuritic effusion for a distended pericardium, as was subsequently obvious on dissection. It has been proposed, somewhat too boldly we think, by Laennec, to inject the serous bag when emptied of its contents with some slightly irritating fluid with a view to inducing adhesion of its opposed surfaces, as in the ordinary operation for hydrocele. Bouillaud, without advocating either the operation or this addition to it, of which he has had no experience, yet thinks that what we know of the history of pericarditis and of its frequent termination in comparatively salutary adhesions, proves that the danger from such a proceeding is at least much less formidable than was once thought. Romero, who has thrice made an opening into the pericardium, in order to evacuate præternatural accumulations of fluid, and twice successfully, makes his incision between the fifth and sixth rib, first into the pleural sac; and then having satisfied himself of the existence of a fluid in the pericardium, he next lays this open with a pair of curved scissors, and lets its contents run off into the pleuræ, from whence they are subsequently drained away by placing the patient in such a posture as favours their escape by gravitation.

During the whole proceeding every care must be taken to prevent the entrance of air. This operation has the advantage over that of Laennec of evacuating any fluid which may happen, as is so frequently the case, to co-exist in the pleural sac; whilst at the same time if an error in diagnosis, similar to that recently alluded to, have been committed, it may be detected in the first stage, the actually existing effusion evacuated, and the additional risk of opening the pericardium avoided. But this or any other operation can scarcely ever be warrantable, except where the affection sought to be relieved is idiopathic, or depending on local inflammation or increased action of the serous membrane. Where there is organic disease of the heart or lungs, or constitutional diseases of the kinds already specified, no judicious practitioner would ever for a moment think of having recourse to it.

SECONDARY EFFUSIONS INTO THE PERICARDIUM.

Fluids of various kinds have been known to make their way into the pericardium from neighbouring organs in which they were originally poured out. Thus those of a *purulent* or *semipurulent* description may get into the peri-

cardial sac in consequence of the bursting of abscesses in that direction which had been formed in the cellular membrane of the mediastinum or in the lung, or from the irruption of a circumscribed pleuritic effusion through the medium of a gradual process of interstitial absorption.

An instance has been recorded by M. Alibert of the rupture into the pericardium of a very large *hydatid* or *serous cyst*, said to equal the fœtal head in magnitude, and which had been developed between the lung, diaphragm, and exterior of the pericardial sac. It had previously considerably displaced the heart to the left side. Its bursting in the manner indicated gave rise to sudden præcordial pain, orthopnœa, tumultuous action of the heart, and a membranous crackling sound, synchronous with the respiration; and was followed by death within a few hours.

A very interesting case has been recently described by Dr. Graves, of *abscess of the left lobe of the liver* making its way through the diaphragm into the pericardium, and also by three several perforations into the stomach. The abdominal tumour which had previously been very obvious, began, soon after the formation of these preternatural communications apparently, to diminish in size, and no longer imparted a sense of fluctuation. but became tympanitic, doubtless from the entrance of air into it from the stomach. The secondary pericarditis thus induced manifested itself in the first instance by the sudden supervention of acute pain, by palpitation, and a sense of burning heat under the left breast; a rough bellows murmur and a species of creaking accompanied both sounds of the heart; and this was converted into a loud frottement when considerable pressure was employed. On the following day a metallic click indicative of the dropping of a fluid, and an emphysematous crackling were present. The patient being eventually run down by diarrhœa, caused by the escape of the purulent matter into the bowels, on dissection the pericardium, which was of four times its natural thickness, was found sprinkled internally with red dots, and arborizations, and coated over with lymph and minute semitransparent granulations. A remarkable case has been recorded by Mr. Thurnam where the pericardium of a man who had been knocked down by a carriage, and thus almost immediately killed, was found filled with blood, though there was no rupture of the heart or great vessels within the sac. The effusion appeared to have its source in rupture of the veins in front of the trachea by the ends of the fractured clavicles, and to have forced its way through the intervening cellular membrane till it reached the apex of the pericardial sac, which it lacerated at length by its accumulation and pressure.

PNEUMO-PERICARDIUM AND HYDROPNEUMO-PERICARDIUM.

When bodies have been kept for several hours after death before being opened, especially when the atmospheric temperature is somewhat high, air is very frequently found within the pericardium, as well as in other shut sacs, and escapes on an incision being made, with a hissing noise. But besides these instances in which the air has obviously its source in *post mortem* decomposition, examples are occasionally met with where there is every reason to believe that it had existed here during life, being evolved generally either during the final struggle, or at the most but a few days before dissolution. It is in such cases almost invariably accompanied by a liquid effusion, from the decomposition of which, if of a fœtid character, it has for the most part its origin, though at the same time we are by no means prepared to deny the pos-

sibility of its being occasionally a product of direct secretion from the vessels. Its presence during life is indicated by a preternatural degree of resonance, of a tympanitic character, elicited on percussion in the præcordial region, as also by a sound of fluctuation produced by the motions of the heart through the elastic and inelastic fluids, as well as by forcible inspirations — a sound compared by Brichetau to the plashing of the wheel of a water-mill. On dissection, if we would ascertain accurately the quantity and quality of the gaseous fluid present, the body should be opened under water in order to facilitate its collection.

Laennec has expressed his belief that those cases in which the sounds of the heart are audible at some distance from the chest, depend for this peculiarity on the existence of air within the pericardium; but in support of this very improbable opinion he adduces no proof.

DISPLACEMENT OF THE HEART.

We have already seen that the heart when greatly increased in size is felt to extend its pulsations to unusual situations, generally more to the left side or lower down than natural; but besides this enlargement of the limits within which it is perceptible, it may be thrust out of its place by various extraneous causes, such as tumours in its vicinity, augmented dimensions of neighbouring organs, and morbid effusions. Such unusual position then, when ascertained not to have been congenital, is to be considered an evidence of some serious organic change having taken place within the thoracic or abdominal cavity.

The most frequent *cause* of this phenomenon is, unquestionably, a large pleuritic effusion, which, according to its situation and quantity, may push the heart over either into the centre of the chest or to the right side, or, on the contrary, further than natural to the left. Hæmorrhage into the pleural sac from injury will have similar results. Sudden and even permanent displacement has been known to result from external violence, as in the remarkable instance recorded by Dr Stokes when it originated in the compression of the chest by a millwheel by which the heart was forced into the right side of the thorax. The individual, notwithstanding the severe symptoms which immediately supervened, survived the accident many years, and was occasionally even capable of taking very violent exercise, his heart ever after continuing to beat on the right side.

Aneurisms of the aorta, pneumothorax, or an emphysematous state of the lung, thoracic and abdominal tumours, ascites, and enlarged liver are amongst the occasional causes by which respectively the heart may be displaced, either downwards, laterally, or upwards. Instances are alluded to by Dr. Stokes where this organ has been felt beating as low as the ninth intercostal space, in consequence of very extensive pulmonary emphysema, a morbid affection which, as has been remarked by an able anonymous writer in the *British and Foreign Medical Review*, must, by the pressure caused by it on the great vessels, tend greatly to the development not only of asthmatic symptoms but of actual organic disease of the heart. It has further been supposed, with great probability, by Dr. Stokes, that the heart may sometimes be drawn over in a very remarkable degree to the right side, by the absorption of a large pleuritic effusion in that part of the chest; especially when it takes place rapidly, and when in consequence of the lungs being closely and extensively adherent, the parietes of the thorax cannot fully accommodate themselves to the diminished contents of the cavity: and a case by Dr Abercrombie, in the *Edinburgh Medical Transactions*, shows that a similar effect may sometimes be produced by atrophy of one lung, accompanied by an hypertrophic condition of the other.

In a case which occurred to Dr. Hope, in which the heart was just so far displaced towards the right, by a pleuritic effusion of the opposite side, as to be impacted between the sternum and unyielding spine, the augmented impulse

was such as to have conveyed to a less experienced auscultator an erroneous idea of the existence of hypertrophy; and Dr. Stokes has known a similar effect produced by tubercular consolidation of the lung behind the heart.

In cases of diaphragmatic hernia, generally of congenital origin, the introduction of the intestines into one side of the chest necessarily displaces the heart more or less to the opposite side. Prolapsus of the heart, or that condition in which, from its unusual weight, and the relaxation of the parts by which it is suspended, it pushes the diaphragm before it, and encroaches on the abdominal cavity, is a very uncommon state, if indeed it is at all to be recognised as a distinct affection. Corvisart, who speaks of it, supposes it capable of causing severe pain in the œsophagus and cardiac orifice of the stomach, difficulty of deglutition, and imperfection of the digestive process, with frequent tendency to nausea and vomiting.

The *diagnosis* of displacement of the heart is based on the results of percussion and auscultation, and the examination of the præcordial region by the eye and by the touch, taken together with the history of the case, from which last we learn whether the phenomena are of comparatively recent origin, or at least not coeval with birth, and so independent of congenital transposition of the organ hereafter to be spoken of. When the displacement is very considerable, the functions of the heart may be much embarrassed, as is manifest from the severe palpitations occasionally complained of in these cases. In the instances described by Dr. Graves and Dr. Stokes, where the heart was thrust upwards and to the right side, as high as the third intercostal space, by an aneurism of the abdominal aorta, the aneurismal tumour itself presented a double pulsation (the first stroke coinciding with the arterial pulse), imparted to it obviously by the contact of the heart: whilst at the same time two sounds were audible corresponding to the natural double sounds of the latter organ. A similar double pulsation was observed by the same authors in a case of aneurism of the ascending aorta, and in two others of a like nature by Dr. Townsend.

HERNIA OF THE HEART.

Hernia of the Heart (*Ectopia cordis*), though of congenital origin, may as well be briefly alluded to here. From original deficiency of a portion of the sternum, cartilages of the ribs, diaphragm, or abdominal muscles, the heart of the fœtus, or new-born infant, may be found protruding either on the exterior of the neck or chest, covered only with the common integuments; or into the abdominal cavity; or finally forming a portion of the contents of an umbilical hernia. Such examples of displacement as are here spoken of, generally occur in connection with other congenital malformations, often from their very nature incompatible with the continuation of existence for any length of time after birth, and are hence obviously rather matter of curiosity than of practical interest. In some very rare instances, however, life has been prolonged even to a very advanced period, notwithstanding the existence of such singular malposition of the heart, as in the very remarkable case recorded by Deschamps, in which this organ was found on dissection occupying the place of the left kidney.

An interesting case of *partial* "*ectopia cordis*," in an infant which survived its birth for three months, has been lately published by Dr. O'Bryen of Bristol in the sixth volume of the *Transactions of the Provincial Medical and Surgical Association*. In consequence of absence of the ensiform cartilage and of the part of the recti muscles and diaphragm usually attached thereto, a portion of the pericardium containing the apex of the left ventricle preternaturally elongated, protruded through the opening, and lay immediately underneath the common integuments, along with a portion of the transverse arch of the colon. In this tumour the following motions were observed: — 1st, a lessening in size

and contraction of its whole body, which was obviously the systole, as being synchronous with the first sound of the heart, and with the pulsation of the carotid; whilst at the same time its whole mass was carried forcibly downwards: 2d, a movement of dilatation during which the tumour became tense and appeared shortened; while at the same time it was much enlarged by as active a force as that of contraction, powerfully separating the fingers when an attempt was made to compress it; immediately after which a sensation was imparted as if of a wave of fluid rushing into it and communicating a thrill to its walls. This movement of dilatation was synchronous with the second sound of the heart, but appeared to continue for some time after it. No distinct period of rest was perceptible after the dilatation. The heart in this as in Harvey's case appeared insensible to the touch. If the phenomenon accompanying the second sound be admitted to have been accurately observed, they afford stronger evidence in favour of an active power of dilatation in the ventricles, than any we have yet met with.

MALFORMATIONS OF THE HEART.

Congenital Malformations.

Transposition of the heart.—Acardia.—Bicardia.

Congenital irregularities in the structure and relations of the heart, as may be deduced from the works of Winslow, Béclard, the St. Hilaires, &c. are referrible either to diseases occurring during the progress of the evolution of the fœtus, inclusive of interrupted development, or else to primitive anomalies in the germ (excess or malposition of parts), or to both these sources together. Of the reality of the second of these causes, we have incontestable evidence in cases of *Transposition of the Heart*, in which the organ is not only placed in the right side of the thorax, but has, moreover, its aortic ventricle turned to the right, and the pulmonary ventricle to the left, and where a similar transposition of all the other thoracic and abdominal organs co-exists, the aorta running down along the right side of the spinal column, the vena azygos along the left; the lung on the right side having but two lobes, that on the left three; the liver, duodenum, head of the pancreas, and the cæcum being in the left side of the abdomen; the great curvature of the stomach, the spleen, and descending colon, lying to the right side.

Such anomalies of position are by no means incompatible with the due exercise of the functions, or with the attainment of advanced age. Though very rare, the practical physician should be aware of the possibility of their occurrence, to prevent the mistaking the physical signs of such irregular congenital conditions for evidence of acquired disease.

Acardia. The heart has been discovered to be altogether wanting in some fœtuses; and this is said by Béclard to be universally the case in acephalous monsters, atrophy or absence of the upper part of the spinal marrow also ordinarily co-existing.

Bicardia. Two hearts have, on the other hand, been found within the chest of the fœtus in some extremely rare instances; but the accompanying plurality of other organs naturally single, has indicated the source of this phenomenon to be the intermixture of two germs.

A case in which *three ventricles* were supposed to exist, has been recorded by Chemineau, but M. Is. G. St. Hilaire thinks it was probably only an example of a supernumerary septum.

A *second appendix* has been noticed, in connection with the left ventricle by De Haen; and we have the authority of Breschet for believing that the pericardium has been observed to be entirely absent.

Preternatural Communication between the two Sides of the Heart.

Forms of preternatural communication between the two sides of the heart. — Cyanosis. — Symptoms of this lesion. —Progress. — Treatment.

Of this, the chief forms are permanence of the foramen ovale, abnormal apertures in other parts of the septum of the auricles, or in that of the ventricles, or in the common point of junction of both septa, throwing the four cavities into one; origin of the aorta or pulmonary artery from both ventricles simultaneously; and continued patescence of the ductus arteriosus.

Many of these irregularities have, in several instances, been known to coexist in the same individual, and frequently along with additional anomalies in the origin of several of the great vessels.*

When only one of these preternatural communications exists, by much the most common is the first of those mentioned above. A mere oblique opening between the over-lapping and imperfectly adhering edges of the foramen ovale does not, however, constitute an example of the malformation or lesion here spoken of; for a valvular aperture of this kind, in consequence of the counterbalancing pressure made on each of its sides simultaneously, will obviously not allow of the mixture of the contents of the adjacent cavities, and accordingly, though it is a condition so often found on dissection (in one out of every four subjects according to Bizot), it is known not to give rise to any morbid symptoms. To have an injurious influence, it is necessary that the opening should be nearly at right angles to the septum, direct and patulous; and even here, many months of early infancy may elapse, ere any very obvious functional disturbance ensues; its first manifestations taking place occasionally during the irritation of dentition, or when the child begins to walk. The diameter of the open foramen ovale, in these cases, varies from two or three lines to upwards of an inch; whilst, in other instances, in place of one large opening, there are several smaller ones. M. Louis, after investigating the matter very scrupulously, has come to the conclusion that the perforated condition, not only of the auricular septum but also of the ventricular, is congenital in almost every instance, as the edges of the aperture are rounded off, smooth, and polished, and occasionally membranous, or even somewhat tendinous, and without any traces of softening or other recent morbid process; whilst further, the co-existent lesions are frequently of an obviously congenital nature, such, for instance, as the permanence of the ductus arteriosus, the origin of the aorta from the right ventricle, &c. The greater frequency of morbid alterations in the right side than in the left, contrary to what is observed in ordinary or acquired disease of the heart, is likewise adduced in proof of a primordial source; as is also the commonly existing contraction or obstruction in the orifice of the pulmonary artery. M.

* In a "Treatise on Cyanosis," by Dr. Gintrac of Bourdeaux, published in 1824, the following results have been deduced from 53 cases analysed by him: — In 33 instances the foramen ovale was open; in 22, aorta arose from both ventricles; in 22, the pulmonary artery was contracted; in 14, the ductus arteriosus was open; in 5, ventricular septum imperfect; in 5, pulmonary artery obliterated; in 4, a single heart, *i. e.* only one auricle and ventricle; in 4, the aorta arose from the right, and the pulmonary artery from the left ventricle (foramen ovale open, and occasionally also the ductus arteriosus); in 1, the aorta obliterated.

The following additional deviations from the natural state have been noticed by other authors: — The existence of two auricles with only one ventricle; or, in other words, total absence of the ventricular septum (*Wolff, Breschet, Farre*); the four cavities thrown into one, from a deficiency of the septa at their common point of junction (*Thibert*, cited by *Laennec*); the pulmonary artery arising from both ventricles, and sending off the descending aorta, — the ascending originating naturally (*Sir A. Cooper*); the right auricle opening into the left ventricle, the ventricles communicating by a preternatural opening, and the auricles by the open foramen ovale (*Holmes*); the right ventricle bifid (*Kerkringius*); the arch of the aorta double (*Bertin, sen.*); the coronary veins opening into the left ventricle; the inferior or the superior cava opening into the left auricle; the foramen ovale *closed* in the *fœtus*; the valves of the heart, adherent along their edges, and consolidated into one substance, leaving only a small central aperture, or else perforated by numerous holes, or altogether absent (*Morgagni, Bertin, Laennec, Destrés*).

Louis does not, however, altogether deny that such openings might in some very rare cases originate in ulceration. The frequency of these exceptional cases appears to M. Bouillaud, on the other hand, much more considerable, in consequence of his having frequently noticed the co-existence of traces of inflammatory action in the lining membranes of the heart along with the unnatural communications alluded to, as well as from the occurrence of the symptoms taking place often suddenly, and for the first time in advanced childhood, or even in adult age. The valves, in particular, according to the same authority, very often present changes of an inflammatory nature, more especially those of the right side, and particularly of the pulmonary artery, the orifice of which is at the same time, and as he thinks, from the same cause, very commonly contracted. We are bound, however, to confess that M. Louis's view of the case seems much the most consonant with the facts, and that the more frequent occurrence of the concomitant lesions or malformations on the right side appears altogether decisive against their inflammatory origin.

The heart in these cases is usually much enlarged, and transversely placed within the chest, the right cavities, and more especially the auricle, being almost invariably the subject either of dilatation, or hypertrophy, or both. When hypertrophy exists, it is not unfrequently, as Bouillaud remarks, of the concentric kind,—a circumstance which has been attributed by Bertin with more ingenuity than probability to the contact of the arterial blood unnaturally admitted into the right cavities. The additional work thrown on the right side of the heart, as well from the opposition encountered in the delivery of its contents through the contracted pulmonary artery, as from its unnatural participation in the labours of the general circulation, would seem sufficiently to account for its being the principal seat of enlargement. Besides, as Dr. Hope has remarked, this hypertrophy is often most considerable in those cases where in consequence of the contraction of the pulmonary orifice, the current through the opening in the septum must decidedly have been from right to left, so that no arterialised blood could possibly have entered the right side.

There are a few cases on record which would seem to show that the foramen ovale may be violently re-opened even in adult age by severe falls or blows, prolonged fits of coughing, or other fatiguing muscular efforts. The sudden supervention of the symptoms is not, however, sufficient to prove indubitably that such is the fact; it may, perhaps, be nearer the truth, even here, to suppose that the malformation alluded to had all along existed, but that it required some unusual derangement of the circulation in order to its revealing itself by external signs.

With regard to the septum of the ventricles, a preternatural opening may be met with in any part of it; but it is certainly found most frequently in that portion which adjoins the auricular septum, near to the insertions of the aorta and pulmonary artery. It is from this cause that the former of these vessels in particular has in these cases often an equal connection with both ventricles.

From the almost invariable co-existence of some of the complications just alluded to (hypertrophy, dilatation, disease of the valves, narrowing of one or more of the orifices, &c.), it is nearly impossible to fix on any set of symptoms as strictly characteristic of the preternatural communications in question.

The bluish colour of the skin of the whole body, and of the face, extremities, and parts covered with a thinner cuticle particularly, which had commonly been looked upon as its pathognomonic sign, and which led to the use of the terms *cyanosis*, *morbus cæruleus*, *the blue disease*, *blue jaundice*, &c. has been clearly shown by M. Bertin and by M. Louis to be often entirely absent; and even when present to depend with much greater probability on co-existent lesions capable of obstructing the course of the circulation, and so causing accumulation of venous blood in the capillaries. So likewise with regard to the frequent co-existing disorder of the heart's action, indicated by palpitations, purring tremor, bellows murmur, fits of excessive dyspnœa, occasionally amounting almost to asphyxia, with proneness to syncope on the slightest

exertions or unusual mental excitement, irregularity and feebleness of pulse, and extreme suffering from defective power of generating heat,—these, together with an occasional tendency to serous effusions, being, as we have already seen, morbid phenomena of ordinary occurrence in cases of enlargement of the heart and obstruction of its orifices, whether from contraction or valvular disease. The narrowing of the pulmonary artery, which so commonly exists in cases of cyanosis, appears to be a very important element in the production of the peculiar appearance of the skin, as it must needs cause, as Morgagni has pointed out, an embarrassment of the circulation through the right side of the heart, and consequent stagnation throughout the whole venous system; and especially at such moments when paroxysms of dyspnœa have been induced, and the circulation is peculiarly obstructed. That the deep colour of the skin, interior of the mouth, &c., occasionally observed, is not a necessary consequence of the mere communication between the two sides of the heart, we have proof, as M. Fouquier remarks, in the fact of its not being observed in the fœtus when such communication naturally exists, and when dark blood is necessarily circulated.

When the communicating cavities are of equal strength, it has been ingeniously suggested by M. Jules Cloquet, that no admixture of their contents in all probability takes place; whereas if the left cavity exceeds the right in power, which in the natural state at least is always the case, the arterialised blood should make its way into the venous receptacles; so that if this view be correct, it may be only in a smaller number of cases that the contents of the right cavities are propelled immediately into the greater circulation; and even here it will not be in such quantity as to account for the deep blue tinge without taking the co-existing sources of obstruction into consideration. M. Louis, on the contrary, believes that, whether the two ventricles be equal in strength or not, no mixture will take place during their contraction, provided all their orifices be free; but as the pulmonary artery is very commonly contracted, a portion of the blood of the right side of the heart will usually make its way through the preternatural opening at the moment of systole, or if not then yet in every case during the diastole, or entry of blood into the cavity; so that a certain degree of admixture will occur in every instance: but this he believes to be quite inadequate to the production of the deep blue or violet colour of the skin, unless the co-existent sources of obstruction in the heart, and consequent stasis in the venous and capillary circulation be taken into account; for the fluids circulating in the cutaneous vessels in most parts of the body are in the natural state colourless; whilst, moreover, in M. Ribes' remarkable case, though the aorta sprung from the right ventricle, and the circulation of venous blood in the arteries must have always existed, yet no such peculiarity in the colour of the surface manifested itself till the third year, when it made its appearance in company with other symptoms of heart disease. M. Breschet, again, mentions an instance where the left subclavian artery arose directly from the pulmonary artery, and yet the colour of the corresponding limb was altogether free from any blue tinge.

Of all the *symptoms* usually attributed to the lesion under consideration, the one in which M. Louis is most disposed to confide is the recurrence of *suffocative paroxysms* at periodical or at least at very short intervals; these paroxysms being often accompanied or followed by fainting, and induced by very inconsiderable causes; whilst, as for the blue colour, it may be either present or absent. The existence of a bellows murmur and thrilling tremor, if permanent and unattended with a marked disposition to dropsy, is considered by Bouillaud as strongly confirmatory of the above symptoms. The blueness of the surface, we repeat, may or may not exist; and even when present, Laennec thought it was often rivalled in intensity by the dark colour of the skin in certain diseases of the lungs, and more especially emphysema; but this Dr. Hope doubts. As active enlargement of the heart is an almost invariable accompaniment of these preternatural communications, there is commonly a very

considerable extent of dulness in the præcordial region, along with increased impulse, and at the same time often a superficial hissing murmur, with the first sound, about the middle of the sternum, in consequence either of the contraction of the pulmonary orifice or of the unnatural aperture through the septum, or both.*

In infants with this malformation, even the effort of sucking is often sufficient greatly to embarrass the respiration and circulation; and the suffocative paroxysms so induced are occasionally accompanied by convulsive movements.

In childhood there is an inability to participate in the sports of that age, the sufferer is disposed to crouch over the fire even in summer, and is very easily benumbed in cold weather. The ends of the fingers and toes are often bulbous as well as discoloured; there is a tendency to cough on making use of any muscular exertion, and pulmonary congestions very frequently manifest themselves under the influence of slight exciting causes. The discolouration of the skin and interior of the mouth is sometimes, as Dr. Hope expresses it, as deep as the stain of the small black cherry. The contraction of the pulmonary artery, which so commonly exists, is looked upon by M. Louis not only as of indubitably congenital origin, as already stated, but also as a chief cause of the prevention of the closure of the aperture in the septum, by means of the over-distention of the right cavities kept up by it.

The *progress* of the disease is very variable. In most cases the sufferers are cut off early, in infancy or childhood, in the midst of one of the suffocative paroxysms: in some instances a precarious existence has been prolonged to middle life, or even to advanced age. One of the cases alluded to by M. Louis reached to the fortieth year, and another to the fifty-seventh, and then terminated by the supervention of a new disease.

The *treatment* of this affection is simply palliative, as its organic cause is irremediable. The judicious management of co-existing diseases in the heart and other organs, together with exemption from mental and corporeal excitement or over-exertion, and from every thing which might hurry the breathing or the pulse, the early reduction of all inflammatory attacks, the enjoyment of a pure mild air, the avoidance of cold and damp, together with great temperance, and a due regulation of the digestive functions, and the promotion of all the natural excretions, are the points towards which attention should chiefly be directed.

* The murmurs indicative of a communication between the two sides of the heart, though not yet fully ascertained, Dr. Hope conceives would be nearly as follows: — "An unusually loud and *superficial* or *near sounding* murmur with the first sound, *immediately* over the semilunar valves (*i. e.* about opposite to the inferior margin of the third rib) is generally seated in the mouth of the right ventricle, and may proceed either from a contraction of the pulmonic valves or orifice, or from an opening out of the right into the left ventricle, or from both these lesions conjoined. If it proceed from contraction of the pulmonic valves or orifice alone, it will be audible along the course of the pulmonary artery, up to the second intercostal space, much more distinctly than along the course of the aorta, and will be attended with a thrill. If it proceed solely from an opening out of the mouth of the right into the left ventricle (the pulmonic orifice being either healthy or totally obliterated), it will be more audible along the course of the aorta than along that of the pulmonary artery. If it proceed from the double lesion, viz. a contracted pulmonic orifice, and an opening into the left ventricle, it will be loudly audible along the course of both vessels, and a thrill will be felt over the pulmonary artery. When these signs of a lesion in the mouth of the right ventricle coincide with cyanosis, the evidence of a communication between the two sides of the heart is almost positive; and as hypertrophy of the right ventricle is usually a concomitant, its presence is a corroborative circumstance. When the signs in question do not coincide with cyanosis, an appeal must be made to the history of the case. If it appear that the patient has exhibited the symptoms of organic disease of the heart from early infancy, yet has never been affected with endocarditis, to which the valvular disease could be ascribed, there are strong probabilities of a congenital malformation, and presumptions of a communication between the two sides, though without so considerable an intermixture of blood, or so great an obstacle to its ingress into the lungs, as suffices to occasion cyanosis."

END OF THE THIRD VOLUME.

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